(Established 1832.)
AMERICAN ENGINEER AND RAILROAD JOURNAL.

JUNE, 1904.

CONTENTS.

FOUR-CYLINDER DE GLEHN COMPOUND LOCOMOTIVE

4-4-2-TYPE.

PARIS-ORLEANS RAILWAY OF FRANCE.

WITH AN INSET.

There is now running on the Pennsylvania Railroad a 4-4-2-type, De Glehn compound locomotive, built especially for that road at the Belfort works of the Société Alsacienne de Construction Mechaniques. This locomotive was ordered by the Pennsylvania in order to make an experimental study of the type which has made such remarkable records abroad and has been adopted as standard construction by all the leading railways of France. As large a locomotive of this type as could be obtained was desired and as there was insufficient time before the opening of the St. Louis World's Fair for a special design to be prepared, the locomotive was built from the drawings of the heaviest De Glehn passenger engines, those running on the Paris-Orleans railway.

Through the courtesy of M. Solacroup of the Paris-Orleans railway and M. A. G. De Glehn, of the Société Alsacienne de Construction Mechaniques, general drawings of this engine are presented in this journal. While the illustrations show the Paris-Orleans locomotive, they also indicate the construction, with the exception of a few relatively unimportant details, of the Pennsylvania locomotive. A somewhat smaller design, that of the heaviest passenger locomotive on the Northern Railway of France, is now in service on the Great Western Railway, in England.

This locomotive is unique in representing a continuous and systematic development of the four-cylinder compound on the divided and balanced principle, which Mr. De Glehn began in 1885. It has steadily increased in favor, and is unquestionably the most advanced type of locomotive in use in Europe, yet there is not a single patent on any part of its construction.

Very little that is new can be said about the De Glehn compound at the present time. Articles by Messrs. De Glehn and Herdner, in this journal, in September and December, 1902, and January and December, 1903, clearly state the principles involved. This design was not developed with special reference to fuel economy alone, but this was an incidental advantage sought. The object was to obtain the utmost possible capacity within a limited weight.

For a locomotive weighing 65 tons, to haul in regular, everyday work, 370 tons behind the tender, a distance of 184 miles, from Paris to Calais, in three hours and ten minutes, with one intermediate stop, and do this on a coal consumption of 38½ pounds per mile, is one result obtained by this system. In this run there is a fifteen-mile hill of one-half of one per cent., and 23 miles of one-third of one per cent. There are four other hills of nearly one per cent., one of which is seven miles long. Under these conditions on the Northern Railway of France, with a locomotive lighter than the one herewith illustrated, a steady speed of fifty-six miles an hour is maintained, on the one-half per cent. grades and 1,500 horse-power sustained. The maximum speed in this run is never allowed to exceed seventy-five miles per hour. It would be difficult for American railroads to match this work with a locomotive of this weight.

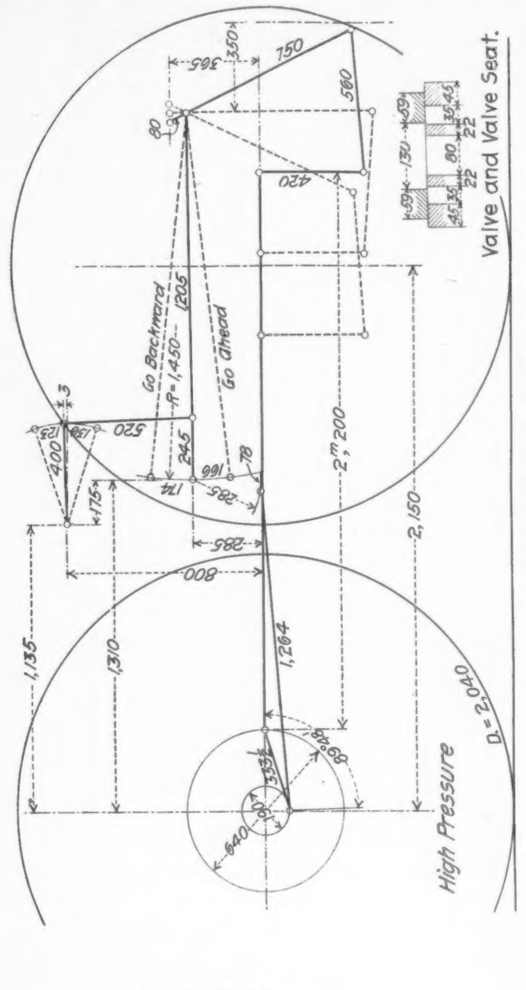
Word has just been received that one of the Paris-Orleans engines, which is exactly like the one illustrated, has just indicated 1,900 horse-power, at 70 miles per hour, with 350 tons behind the tender, the drawbar pull at that speed being 7,350 pounds. It must be remembered that this engine weighs only 80 tons. Mr. Sauvage in his recent paper before the Institution of Mechanical Engineers of England stated that one of the Paris-Orleans engines hauled 350 tons (behind the tender) for 200 miles at an average speed of 55 miles per hour, and for 73 miles the average speed was 63 miles per hour. From indicator diagrams the effective power was from 1,200 to 1,800 horse-power, the water consumption being not more than 24 pounds per indicated horse power per hour, as an average from a number of experiments. The boiler evaporated 7.7 pounds of water per pound of coal.

The essential principles of this type are: 1. Four cylinders, the low pressure between the frames and underneath the smoke box, being coupled to the leading crank axle; the high pressure being outside the frames and further back, coupled to the rear driving wheels, thus dividing the stresses of the cylinders upon the axles and the cylinders upon the frames and balancing the reciprocating parts. 2. Each cylinder has its own valve and valve gear, the high and low pressure valves being connected to separate reversing screws, which, however, may be coupled together in their operation from the cab. This renders it possible to change the ratio of expansion between the cylinders and it also divides the work which each valve gear has to perform. 3. A starting valve admits boiler steam to the low pressure cylinders and opens the high pressure exhaust to the atmosphere. This is controlled from the cab and makes it possible to use either high or low pressure cylinders alone in case of a break-down, in addition to the function of increasing the starting power of the engine.

The remarkably fine set of drawings reproduced in the inset accompanying this issue must be allowed to speak for themselves, and they are well worthy of careful study. In reproducing the drawings the metric system units are retained as it is undesirable to attempt to translate them. Attention is called to the Walshaert valve gear, with two eccentrics on the crank axle for the inside cylinders and return cranks for the outside cylinders. The plate frame construction is exceedingly interesting in the depth of the plate at the driving boxes and its reinforcement at this point. The depth here is nearly 35 in.

The bracing of this frame is remarkable. The bracing

occurs at the bumper, at the low pressure cylinders, a box casting at the high pressure cylinders, between the driving wheels, in front of the fire box and at the draw casting. Most of these braces are very deep and they will permit no weaving or twisting of the frames. This frame construction is flexible horizontally, very stiff vertically, and frames seem to be very free from breakage in France.



HIGH-PRESSURE MOTION.

LOW-PRESSURE MOTION.

DIAGRAMS OF VALVE MOTIONS, DE GLEHN 4-CYLINDER COMPOUND LOCOMOTIVE.—PARIS-ORLEANS RAILWAY.

The boiler is long and is not packed full of tubes; the tubes, 139 in number, are 14 ft. 5 in. long and of the Serve ribbed type of 2 9-16 in. inside diameter. The tube spacing provides plenty of room around the group for circulation of water between the tubes and the shell. This is shown in one of the sectional drawings. The grate has a sharp slope and is narrow. It is designed for coal which is rather better than ours, and for American conditions a wide fire box would be exceedingly desirable.

The smoke box is perfectly clear of obstructions. It has no steam pipes or diaphragm, the stack, which is 20⅛ in. at the top and 17¾ in. at the bottom and 2 ft. 8⅞ in. high, is extended downward into the smoke zox, with a flaring base. The exhaust nozzle is high and fitted with a variable exhaust attachment; as used in France this device is invaluable. The stack has a plate cover, which is a great protection to the fire box and tubes when closed.

In this particular locomotive the low pressure cylinders develop somewhat less than half the total amount of work and the crank axle is therefore relieved of that proportion of the work which it would have to do if all four cylinders were coupled to the same axle.

The reciprocating parts are very light. The crossheads weigh 238 pounds each; the high pressure piston, 100 pounds; the low pressure piston, 242 pounds; the high pressure main rod, 278 pounds; low pressure main rod, 425 pounds.

An examination of this locomotive is convincing of two things: First, that the design, as a whole and in every specific detail, has been carefully and systematically studied and, second, that the operation of such an engine must be carefully looked after. The fact is that American roads are not up to the handling of locomotives like this. Instead of condemning the design this is one of its strongest recommendations, indicating, as it does, how far foreigners are in advance of us in the handling of locomotives on the road. The work which the French engineman gets out of light locomotives is also an important study for our roads.

American railroad men, on examining these drawings, are sure to express their impressions in the word "complicated." There is no question of the fact that in order to get more work out of the weight allowed for locomotives more complication than that of current American practice is absolutely necessary. In order to secure the necessary results, under present conditions of train operation, it is necessary that methods of treating locomotive running repairs should be radically improved, even for present simple methods of construction. If our ordinary locomotives are to give satisfactory service, they must be properly maintained and methods which are really adequate for the proper maintenance of ordinary two cylinder, single expansion locomotive will be sufficient for taking care of more complicated machines. The trouble is that maintenance methods now are known to be grievously at fault, and must be improved irrespective of improvements in the locomotive itself.

There is nothing about a railroad train as complicated as the air brake. We must have the air brake and must maintain it for what it will do. If by complicating the locomotive, more work can be had per ton of weight, the complication is justified exactly as it has been in marine and stationary practice. The value of the complication in this particular locomotive will soon be ascertained on the testing plant at St. Louis.

GENERAL DIMENSIONS, DE GLEHN COMPOUND.

PARIS ORLEANS AND PENNSYLVANIA RAILROADS.

Weight—On driving wheels	79,500 lbs.
On truck	46,500 lbs.
On trailers	34,000 lbs.
Total, in working order	160,000 lbs.
Tender, loaded	132,500 lbs.
Wheel Base—Driving	7 ft. ½ in.
Truck	7 ft. 6½ ins.
Total, engine	28 ft. 6½ ins.
Tender	20 ft. 6 ins.
Total, engine and tender	59 ft. 5 ins.
Driving wheels, diameter	6 ft. 8 3-16 ins.
Truck wheels, diameter	3 ft. 1 13-16 ins.
Trailing wheels, diameter	5 ft. 11-16 in.
Cylinders—Diameter..High-pressure, 14 3-16 ins.; low-pressure,	23⅝ ins.
Stroke	25 3-16 ins.
Boiler, straight top—Diameter	4 ft. 11⅛ ins.
Pressure	227 lbs.
Tubes, Serve, ribbed—Inside diameter	2 9-16 ins.
Length	14 ft. 5¼ ins.
Heating Surface—Tubes	2,435.7 sq. ft.
Firebox	181.1 sq. ft.
Total	2,616.8 sq. ft.
Grate area	33.9 sq. ft.
Capacity of tender	Water, 5,500 gals.; coal, 22,000 lbs.

Length of engine	42 ft. 8⅝ ins.
Length of tender	28 ft. 3¼ ins.
Length from pilot to tender coupler	70 ft. 11⅞ ins.
Width of engine	9 ft. 9½ ins.
Height to center of boiler	8 ft. 10 5-16 ins.
Firebox—Length inside	10 ft.
Width inside	4 ft. ½ in.
Thickness of plates (sides, crown and back)	⅝ in.
Tube sheets, thickness of	1 5-16 ins.
Valve gear	Walschaert's
Steam ports:	High-pressure, 14⅛ x 1⅜ ins.; low-pressure, 20½ x 2 1-16 ins.
Exhaust ports:	High-pressure, 14⅛ x 3⅛ ins.; low-pressure, 20½ x 3⅛ ins.
Bridges	High-pressure, ⅞ in.; low-pressure, 1 1-32 in.
Eccentric throw	High-pressure, 7 15-32 ins.; low-pressure, 9 1-16 in.
Valve travel, maximum:	High-pressure, 5½ ins.; low-pressure, 5 9-16 ins.
Outside lap	High and low, 1 1-16 ins.
Lead, full forward gear:	High-pressure, 5-16 in.; low-pressure, 9-32 in.

RATIOS, DE GLEHN FOUR-CYLINDER BALANCED COMPOUND.

Maximum tractive force, operating simple (lbs.)	18,270
Maximum tractive force, operating compound (lbs.)	19,527
Volume of two high-pressure cylinders (cu. ft.)	4.61
Ratio total heating surface to volume high-pressure cylinders	559.24
Ratio low-pressure to high-pressure cylinder volumes	2.77
Tractive weight to total heating surface	30.85
Tractive weight to tractive effort, compound	4.07
Tractive weight to tractive effort, simple	4.35
Tractive effort to heating surface, compound	7.58
Heating surface to grate area	77.16
Heating surface to tractive effort, compound	13.19%
Total weight to total heating surface	62.09
Tractive effort × driving-wheel diameter to heating surface	609.95

BIG LOCOMOTIVES OVERLOADING AND LOCOMOTIVE FAILURES.

In order to ascertain the attitude toward and the appreciation of the position of the big locomotive, five questions were addressed to a number of leading railroad officials as follows:

1. Are big locomotives satisfactory?

2. Are locomotive failures increasing as the size of locomotives increases?

3. If so, is it due to the fact that the locomotives are big, or to overloading?

4. Stated generally, is it not good policy to load engines lightly enough to get an average speed of, say, about 15 miles an hour when business is heavy and to load them heavily when business is light?

5. Given a distance of, say, 6 miles between side tracks, is not the capacity of the road limited by the time required for the slowest train to make this distance?

The replies constitute a remarkable reflection of opinions from some of the best operating men in the country. What these men say on any subject will be eagerly read, but their comments on the increasing size of locomotives and its effect on questions of operation and maintenance must be considered as specially significant of the necessity for proper design, operation and adequate facilities for maintenance of big locomotives.

DELAWARE, LACKAWANNA & WESTERN RAILROAD.

1. Our experience with such locomotives, being the standard consolidation freight engines we are using and which we have been buying for several years, is, I think I may say, entirely satisfactory. We are so well satisfied with these that we are buying more each year to take the place of the lighter engines we are retiring from service.

2. Our experience does not show that locomotive failures are increasing as result of the larger power we are using. I think probably during the last three years locomotive failures have increased in number, as compared with the similar period immediately preceding, but my view of this is that the abnormally large tonnage handled, with the general shortage of power, has required the railroads to run their locomotives harder and with less attention in shops and round-houses than previously, and as a result of trying to get increased mileage out of them in this way failures on the road have appreciably increased.

3. It is quite possible, too, that the desire of the transportation department to get as much service out of the locomotives when on the road as possible has led to their being overloaded at times, and this, of course, is bound to result in more failures.

4. Generally speaking, I should say that it is not good policy to load engines to an extent that results in their dragging along over the road, making a low rate of speed and getting in the way of other trains. As a result of our practice in this regard we feel that it is better to give a fair load and one that will enable slow freight trains to make 15 to 18 miles an hour running between stations and thus get them over the road in good time. More service can be gotten out of engines and crews both in this way than by loading the engines to the very last limit. Especially is this true on lines having as heavy traffic as ours.

5. I think, without question, the capacity of the railroad is limited to a great extent by the time required by the slowest trains to make distances between the passing points along the line.

W. H. TRUESDALE, President.

SEABOARD AIR LINE RAILWAY.

1. I believe there is great economy in the use of heavy engines. The maximum economic weight of the engine used must, however, be adjusted to the conditions under which traffic is moved. I do not believe it would be economy to use in road service as big an engine as could be economically used on mountain grades.

2. Engine failures have increased with increase in size of engines. I do not know whether the ratio of increase in engine failures agrees with the ratio of increase in weight.

3. I believe the increase in failures with big engines is due to overloading and increased steam pressure carried, in comparison with pressure formerly carried by engines of less capacity.

4. It is economic, and therefore good policy, not to load heavy engines in excess of their efficient rating. This must be determined by traffic conditions. When the movement of business is heavy a larger tonnage can be successfully moved by reducing the engine rating measurably. When traffic is light engines can be loaded economically up to the limit of their efficient rating.

5. The capacity of a railroad is limited by the time consumed by the slowest train moving between stations.

J. M. BARR, President.

NORFOLK & WESTERN RAILWAY COMPANY.

1. The larger engines now in use are not only satisfactory but, in my opinion, have proven to be an absolute necessity, because the vastly increased traffic would have been congested to a greater extent but for the increased train load and relatively decreased train mileage effected by increased capacity of engines.

2. The increased size of locomotives has increased the number of engine failures, but I do not think that the increase has been out of proportion to what should have been anticipated under the new conditions brought about thereby, and that when railways have adjusted their methods and facilities to the new conditions requiring time and the expenditure of money the failures will not show a relative increase. The increased failures are also due to the improved method of loading engines up to their capacity from the beginning to the end of runs, over the minimum as well as the maximum grades, which has been effected by a more perfect system of helper and pusher service, and practiced to a greater extent since the introduction of the big engines, whereas engines formerly were fully loaded only on mountain grades, and hence were very lightly loaded over the greater distance run.

3. The increased failures are due to new conditions referred to in answer to question 2.

4. In my opinion, engines should be loaded up to their effective rating, which is a load with which they can make maximum speed with class of freight hauled, while under way.

5. In my opinion, the necessity for passing sidings is determined by the time between terminals, hence on a train basis the capacity of a road is limited by the time consumed, and not by the distance, between side tracks.

L. E. JOHNSON, President.

BUFFALO, ROCHESTER & PITTSBURGH RAILWAY COMPANY.

1. As big locomotives are termed to-day weighing anywhere from 230,000 to 300,000 lbs., we have none of these which could be considered as our engines weigh only about 180,000 lbs. in working order. If you assume to call these big engines, our records show them to be very economical. They not only make their mileage, but the cost to operate them per mile is low. Comparing these engines with the lighter or smaller type of engines, we find the cost for repairs, coal and water consumed, are approximately proportional to

their hauling power. The oil, wages, and various supplies cost per mile is slightly greater for the larger engines than for the smaller ones.

2. Our experience and records show that we have no more failures with these engines than with the smaller ones.

3. In our opinion it is a good policy to load engines light enough to make an average speed of fifteen miles per hour when business is heavy.

4. Given a distance of, say, six miles between side tracks, we have but one or two places of this kind, and do not think it a good policy to run trains so slow as to delay other traffic on the line. In our opinion, it is very bad policy to load engines down to such an extent as will cause them to stall or make very slow speed. It deprives the railroad company of their use and keeps the men on duty too long a time so that at the latter end of their trips they are tired, naturally indifferent to all surroundings as well as to their own lives.

A. G. YATES, President.

THE WABASH RAILROAD COMPANY.

I am sorry I have not the time to go into the several questions you ask thoroughly and answer them at length and in detail. As I have not the time to do this I am practically confined to a categorical reply:

1. This question is rather indefinite and a good deal like the question, "What is the size of a lump of chalk?" I presume, however, you refer to the very large locomotives of from 180,000 to 200,000 lbs. on drivers. I have not been an advocate of the very large engine, the reasons for which are numerous, among the most important being:

First: The large increase in the cost of car repairs due to handling very large trains. There is such a large percentage of old and light cars still in service that it is difficult to make up a train of general traffic without having several such cars in it, and with large engines these cars are apt to cause trouble. Even with trains of modern cars the damage to the draft timbers and rigging in the starting and stopping of these trains is considerable.

Second: The track and maintenance repairs are very largely increased by the running of unusually heavy engines. The saving of a few cents per ton mile in wages of trainmen can very easily be offset by increased cost of track maintenance and car repairs.

2. Are locomotive failures increasing as the size of locomotives increases? I will not say that locomotive failures increase as the size of the locomotives increases, but the expense of maintaining and repairing locomotives is, of course, much greater for large than for small engines.

3. If so, is it due to the fact that locomotives are big or to overloading? Repairs of locomotives ordinarily are due to the use made of them. If they were not used at all it would cost no more to keep up a big engine than a small one, and therefore the trains they haul and the speed at which they are run and the shocks received due to heavy trains are the principal elements of repairs and, of course, the effect of these elements is practically proportionate to the size of the locomotives. The element of loading is, of course, a great factor in repairs, as an overloaded engine, like an overloaded man, is bound to break down in some part much sooner than it would if the work done was well within the limits of the power of the locomotive or of the man.

4. The policy of the Wabash is to so load and rate an engine that it can make its schedule time without difficulty—in fact, so as to have a little reserve power left in order to make up some time when the train is laid out at a meeting point. Under the present strict rules of overtime in force on almost all roads, it is not economical to load an engine down to the last notch. It is better to get the engine and the traffic over the road on time and have the engine get out promptly on its next run than to put on the last car possible for it to haul and then have the train delayed, thus adding to the expense of operation and bring forth complaints from shippers, etc. Of course, such a policy does not induce the highest tonnage possible per train mile, but in my opinion, the loading per train mile, while it is a desirable thing up to a point where other factors should be considered, can easily become a fad which may be detrimental to the interests of the company and really increase, instead of decrease, the expenses of operation.

5. This is rather a theoretical proposition and it may be that I do not fully grasp the meaning of the question. The capacity of a road is limited or affected by a great many factors, the principal factor governing the capacity of a road being that of grades. I assume, however, that the intent of your question is more as to the capacity as to the number of trains than the capacity for tonnage. Of course, on a single-track railroad the frequency and length of sidetracks is a most important element in the number of trains which can be handled and the delays which would ensue while one train was waiting for another to pass. The slowest train run on a road is generally the train of the least importance and the one which is sidetracked and has to keep out of the way of the higher grade and faster trains, and therefore the slowest train, in my opinion, would not be the limiting factor in regard to all the traffic of a road. I should say it would be very apt to be the average speed of trains, say trains running at an average speed of 15 miles an hour.

J. RAMSEY, JR., President.

CHICAGO, BURLINGTON & QUINCY RAILROAD.

1. Are big locomotives satisfactory? Yes, in a general way, although this does not mean that all big locomotives are satisfactory. It is not strange that when the capacity of locomotives was increased so enormously that the executed designs prove faulty in a good many details. When we have had as much experience with locomotives of modern capacities as we had with locomotives built and "tried-out" 15 years ago, we shall have evolved a satisfactory machine.

2. Locomotive failures are certainly increasing, but on the best railroads I doubt if they are increasing anything like as rapidly as the capacity of the locomotives have increased; that is to say, on a well-regulated railway I believe that locomotive failures are much less in proportion to any unit of work done than formerly. It is not quite fair to measure locomotive failures in proportion to the miles run for freight service; the tons hauled one mile, and in the passenger service, the speed and weight of train must be taken into consideration.

3. I should say that a good many failures have been due to overloading, or to want of intelligent loading. The most frequent cause of failure with engines of large tractive power on low grade lines is entire deficiency in boiler capacity. The demands on a locomotive boiler to furnish steam to an engine of large tractive power loaded to full rating on a low grade line are far in excess of what is considered good practice with stationary boilers and probably cannot be met unless the boiler is considerably enlarged or its efficiency increased by use of automatic stokers; even automatic stokers, however, will not dispose of the ashes and clinkers, and keep the fire in the condition in which it must be maintained to develop the required horse-power for a good many hours at a stretch.

4. Stated generally, is it not good policy to load engines lightly enough to get an average speed of, say, about 15 miles an hour when business is heavy and to load them heavily when business is light? I should say that the question of speed would depend largely on the character of the railroad. On single track lines and on many double track lines, it is necessary to keep trains moving at 15 miles per hour in order to make an average speed of 10 miles per hour, or better, over the divisions. It is also a fact that in busy times trains cannot be loaded quite as heavily, and keep the road open, as they can when business is dull and there is less traffic congestion.

5. The capacity of the road is not only limited by the time it takes for trains to run from one passing track to another, but also the time it takes for trains to get into clear at those passing tracks. For that reason the capacity of a road is very much increased by having heading-in passing tracks operated with interlocking, so that trains can head in and get out of the way as quickly as possible. By the same token a good deal is saved if trains can move through the passing track and pass out at the other end without any back-up movement. The ideal train movement is obtained when trains may be passed by each other at passing tracks without stopping either train. A very near approach to this can be obtained with good lap sidings, and in winter weather the avoidance of delays on passing tracks has a very important effect in reducing not only engine failures, but train failures, hot boxes, etc.

F. A. DELANO, General Manager.

ILLINOIS CENTRAL RAILROAD COMPANY.

1. Are big locomotives satisfactory? Yes.

2. Are locomotive failures increasing as the size of locomotives increases? Yes.

3. The difficulty experienced with the larger locomotives is principally caused by flues or staybolts and packing. This is on account of greater amount of work performed by the larger engines due to increased size, and more particularly due to the increased pressure which these engines carry. On this system engines of all classes are required to haul a tonnage in accordance with their size and capacity, and the failures of the larger engines under the circumstances are increased by reason of the additional number of parts, as the latter are principally of the consolidation type.

4. This would be largely due to the nature or character of the principal traffic on any district in question. On this road our dead freight trains are scheduled to make about an average of ten miles per hour, while the higher class trains run an average of from 15 to 20 miles an hour.

5. There is no question but that the distance between side tracks, particularly on single-track road, governs the road capacity for moving the freight business, and where the traffic is heavy I regard an average of six miles distance between side tracks too great. Four miles would, in my opinion, be the proper distance.

J. T. HARAHAN, Second Vice-President.

GRAND TRUNK RAILWAY SYSTEM.

1. Big locomotives are not entirely satisfactory.

2. Locomotive failures are increasing as the size of locomotives increases.

3. These failures are due both to increase in size and to overloading.

4. It is good policy to load engines lightly enough to get an average speed of, say, about 15 miles an hour when business is heavy and to load them heavily when business is light.

5. On a given distance of six miles between side tracks the capacity of the road is limited by the time required for the slowest train to make this distance.

Notwithstanding the fact that increased tonnage is handled by the more modern locomotives (which are merely the style of locomotives formerly used but of increased dimensions) as is shown in the foregoing answers to questions, the gains made by their use are by no means net, for the reason that they cause much more wear to the track and rack the equipment, making the cost of maintenance excessive, and this condition will continue until the lighter constructed cars are superseded by the cars of modern construction. The heavy locomotive, however, is a necessity in passenger service as well as freight. The travelling public demand modern equipment and high speed in order to give the comforts that are necessary and the increased protection to the passengers, and on account of the high speed extra heavy equipment is required. Ten years ago passenger coaches of 60,000 lbs. weight were common. To-day a modern coach weighs over 100,000 lbs., sleeping cars, parlor and dining cars weighing as much as 135,000 lbs. It can readily be seen, therefore, that this extra tonnage, together with the increased speed, requires enormous power, which can only be secured by the use of the exceedingly heavy locomotives.

CHARLES M. HAYS,
Second Vice-President and General Manager.

THE ATCHISON, TOPEKA & SANTA FE RAILWAY SYSTEM.

1. "Are big locomotives satisfactory?"—Very decidedly.

2. "Are locomotive failures increasing as the size of locomotives increases?"—I do not think so. The number of miles run per engine failure on the Santa Fe System is much greater this year than last, and we have been receiving new and large locomotives constantly during the last twelve months.

3. The size of the locomotives, in itself, has nothing to do with the matter. Some large locomotives are not properly designed, because of the fact that it is, and always has been, customary with railroads to find out how large the various parts of a locomotive should be, in order to avoid breakage, and then to make them stronger. This necessarily involves more or less breakages until the facts are determined. One of the principal causes of engine failures is the choking of the boiler with an unnecessary number of flues, in order to secure greater heating surface. Much of this trouble has been attributed to the wide firebox. While this feature of modern engines has been carried to extremes in some cases, it is a fact that fuel is much more economically and effectively burned in wide fireboxes than was formerly the case in narrow ones. The evaporation of largely increased volume of water, in modern boilers, must result in a corresponding increase of solid precipitates, or scale. It is more than ever necessary to purify feed water, but this important matter has received relatively little attention. Imperfect circulation, due to narrow water legs and excessive number of flues, has resulted in many burned side sheets, and this disaster has been attributed by various people to various causes—among others, to the quality of coal used. When from three waterleg gauges dry steam may be taken, while the engine is in service, further conjecture as to the cause of burned side sheets seems to be unnecessary.

4. In the opinion of the writer, an average speed of 12 or 13 miles an hour is more desirable than 15 miles per hour. Either term is indefinite, in a measure, because much depends upon detention enroute, the term "average" applying to the distance between terminals, divided by the time, from hour and minute of departure to hour and minute of arrival. Engines should be loaded only to such an extent that it will be practicable for them to make the desired schedule time, be it 12, 15 or 20 miles per hour; and all engines should be so proportioned as to regularly perform this service without machinery failures, it being understood that no machinery can be indestructible, and that breakages must occasionally occur. When business is heavy, engines should be given uniform loads, in accordance with the above statement. When it is light they will, in most cases, have to take what offers, and at such times, if the business is balanced, a lighter engine will prove preferable. With inferior business it will usually be practicable to delay forwarding until there is an accumulation sufficient to afford full load for the engine to be employed. While it may seem that this practice, if followed, will result in delays which will seriously affect the volume of business, especially where competition is sharp, a matter of a few hours at originating terminals is not of vital importance, if the train is kept moving afterward.

5. The slowest train—assuming that only one coming under this category is on the district at a time—can only affect the opposite movement of trains over successive blocks of six miles. The slower the trains, the smaller the tonnage capacity of a single-track road, but the delays incident to meeting or passing by freight trains is much less in the aggregate than is the delay of freight trains incident to the movement of passenger trains. In any case, much depends upon the distance between telegraph offices.

I wish to voice a protest against the conclusions which are in some instances preceding known facts, concerning the operation of so-called heavy engines. Many companies have purchased large engines, but have not made adequate provision for their maintenance. Naturally, it is not to be supposed that a plant which would satisfactorily take care of engines twenty years ago can perform the same function with respect to modern locomotives. The care of the modern engine requires a modern shop, and so does the proper and economical care of an antiquated locomotive. One can hardly expect to employ an engine of double the weight of those formerly used and to maintain these engines at the same cost per mile run. In fact, this unit of cost is obsolete and should be discarded in favor of one which will establish the cost per gross ton mile transported, meaning, of course, the weight of the cars and contents, but omitting the weight of the engine, which from necessity must propel itself.

J. W. KENDRICK, Third Vice-President.

NASHVILLE, CHATTANOOGA & ST. LOUIS RAILWAY.

1. Big locomotives are satisfactory provided they are not too big. Am quite sure the limit has been exceeded in some instances. Local conditions should govern to a very great extent. Our latest engines:

Weigh	165,000 lbs.
Cylinders	21 x 28 ins.
Diameter of driving wheels	55⅝ ins.
Steam pressure	195 lbs.

These engines are as large as can be used economically at the present time by this company from the fact that we find it necessary to limit the number of cars in the trains, this being brought about by the inability of the draft rigging to withstand the strain of starting longer trains on heavy grades. This 50-car limit applies to the Chattanooga division, where there are any number of grades 50 to 80 ft. per mile. On the Atlanta division, where the grades are 35 ft. per mile, these same engines are limited to 60 cars.

2. Am afraid they are. This should not be the case were the engines well designed. Our principal trouble is from flue failures. Longer flues, larger flue sheets, higher steam pressure, shallow fireboxes of the wide fire-box type, all tend to make life a burden so far as leaky flues are concerned.

3. In a great many instances, failures of large engines are caused from faulty design or poor workmanship. The tendency is to overload, the inevitable result of which is engine failures. Our rule is to rate the engines so they can get over the road nicely, and conductors have instructions to set off cars rather than take possession of the road.

4. Engines should be rated so as to make 12 or 15 miles per hour over the heaviest grades, and to do so without running fuel consumption up.

5. Yes and no. Yes, if there are practically the same number of trains each hour. No, if the trains are bunched, which is usually the case. There are hours when there are but few trains between certain stations, and at such times it makes but little difference

whether trains are 30 or 40 minutes covering the 6 miles. During the busy hours, the time of the slowest train does limit the capacity of that part of the road crowded with trains.

J. W. THOMAS, JR., General Manager.

——— & ——— RAILWAY.

1. Big locomotives are not entirely satisfactory.

2. Locomotive failures increase as the size of the locomotives increase.

3. I do not think locomotive failures are due to the fact that the locomotives are too big or to overloading. I think they are due largely to bad workmanship and lack of knowledge of the machine. A high pressure locomotive must be very well put together and carefully designed to do its work with satisfaction.

4. I believe it is good policy to load engines so they may make a reasonable speed, but this depends entirely on the facilities. A four-track road can load engines heavily for a low speed and a double-track road with ample sidings and a comparatively light passenger traffic can do the same. On a single-track road with heavy passenger service and fast freight business low-speed trains will be seriously in the way.

5. The capacity of the road is, of course, limited by the time required when slow trains are occupying the track, but this would not necessarily be all the time.

— — ———, President.

CHICAGO & NORTH WESTERN RAILWAY COMPANY.

1. Are big locomotives satisfactory? We have found ours entirely so. They are not, however, of the largest existing type, our maximum weight on drivers being 126,000 pounds. We have no compound engines.

2. Are locomotive failures increasing as the size of locomotives increases? Our experience is not in the affirmative. Our company has increased its shop facilities and the efficiency of its tools to the extent that we have been able to give prompt attention to running repairs, and where running repairs are kept up it oftentimes eliminates the necessity for any great enlargement of the so-called "back-shop." This also disposes of your third inquiry.

4. This inquiry has a pleasant sound and in the abstract our reply is in the affirmative. It is an accepted fact that one of the principal yard sticks of railway operation is freight train tonnage. That is what we all strive for, but there is a great difference in various roads on account of their localities and the business which they handle, also with different parts of the same road for the same causes; therefore, in actual practice one must be governed by the conditions which confront him at the minute. In other words, train service in our territory at least must accommodate the traffic and we cannot always make the traffic subordinate to service that we would like to maintain.

5. Given a distance of, say, 6 miles between side tracks, is not the capacity of the road limited by the time required for the slowest train to make this distance? I assume this is from the standpoint of a single-track line without any intermediate blocks between sidings. We have been able to very much increase the capacity of various parts of our line by the introduction of intermediate manually controlled telegraph blocks, dividing it up into sections of 2½ to 4 miles each.

W. A. GARDNER, General Manager.

BANGOR & AROOSTOOK RAILWAY COMPANY.

1. I don't know what you would call a big locomotive. The smallest one now would have been big fifty years ago. The biggest one now may be small fifty or even twenty years hence. The smallest one now might be big for certain purposes under certain (existing) conditions, and the largest one not large enough under conditions wholly possible through money outlay. I don't think the question of motive power can fairly be considered by itself.

2. Not on this road.

3. I do not permit overloading and cannot answer for those who do.

4. I do not think the question can be fairly or intelligently answered as one which applies generally. Over sections of roads almost anywhere "yes." Over other sections not "yes" and not "no" without knowledge of many other conditions than appear in your premises.

5. I should have to say, "not necessarily and perhaps yes."

My comment upon "1" involves principles applicable throughout, the answers to be determined upon each railroad, after study and full knowledge of the conditions as they are or as they may be made. Somebody asked somebody else, so I've read, what he thought the best way to "bring up" a boy. "Show me the boy," the somebody else replied.

I claim to know little about large railroads and large engines on them. I express myself according to my light and in response to your courteous request. Very truly yours,

F. W. CRAM, President.

THE NEW YORK, CHICAGO & ST. LOUIS RAILROAD COMPANY.

1. I think, as a whole, big locomotives are satisfactory.

2. While I have no data from which to make accurate statement, I think it quite probable there are increased failures of big locomotives in comparison with the smaller ones.

3. If so, a portion of the trouble may be ascribed to the larger locomotive, and also, in many instances, to overloading. Another factor during the past winter has been the very unusual weather conditions.

4. I think where conditions will permit, it is good policy to load engines so that an average speed of about 15 miles per hour can be maintained, the same to apply when business is heavy or light.

In answer to your fifth inquiry: I am not prepared to give an opinion on this subject, although I am inclined to think the inference to be derived from your question is correct.

W. H. CANNIFF, President.

PERE MARQUETTE RAILROAD COMPANY.

1. *Small* locomotives are not satisfactory.

2. I do not think locomotive failures are increasing by reason of the use of large locomotives in any greater ratio than the number of ton miles hauled per annum per engine.

4. I do not think it is as necessary to change the loading of engines when business is heavy as it is to consider the temperature and other conditions in giving the load.

5. I presume when you refer to the capacity of a road you mean the business moved by a greater or less number of trains over the road. As I view it, the real question is not how many trains can be moved over the road, but rather how much tonnage can be moved. Speaking generally, I believe the capacity of a road can be limited by having crews on the road too long; while, on the other hand, the capacity may be sacrificed by running below the point where a crew might get over the road in a little longer time with largely augmented tonnage.

M. J. CARPENTER, Vice-President and General Manager.

CHICAGO GREAT WESTERN RAILWAY.

1. Very large locomotives may be satisfactory in certain service, but I believe that their performance in general has been disappointing to most of the railroads which have bought them within the last few years. I believe that we have all gone ahead too fast in the way of big engines.

2. With us, locomotive failures are not increasing as the size of locomotives increases, although the nature of the failures has changed more or less. The principal trouble now comes from leaking flues.

4. Yes.

5. The distance between side tracks is certainly a limiting factor in the capacity of a single-track road.

TRACY LYON, Assistant General Manager.

UNION PACIFIC RAILROAD COMPANY.

1. Big locomotives are satisfactory, because they are made necessary by the increased demands of the public for improved facilities and reduced rates; and the employes for higher pay. Otherwise we would not be able to maintain the integrity of our securities.

2. Are locomotive failures increasing? Locomotive failures are more frequent with large power than with small. Locomotives with high steam pressure are most affected by poor water than the smaller locomotives.

3. The failures of large engines are not especially due to increased tonnage, but in a number of instances are caused by inferior material and workmanship.

4. It is good policy to give engines for slow freights their full complement of tonnage. The speed regulation is governed by the grades and the atmospheric conditions during different seasons of

the year, as well as water; and by the competition occasioned by other lines; and the necessity for operating perishable freight and live stock at different rates of speed.

5. To a certain extent, yes. In dull times more tonnage can be handled, under similar weather conditions, without overtime than in busier times, caused by the loss in meeting and passing trains. The economical "speed limit" can best be determined on each road according to its necessities and the character of fuel that it uses. The large locomotives are the means of reducing the number of trains—reducing the volume of accidents and the cost of the service.

The very decided increase in the cost of all kinds of material operates adversely, in connection with the increased cost of labor and reduction in rates, in producing the best results.

A. L. MOLER, General Manager.

INTERNATIONAL & GREAT NORTHERN RAILROAD COMPANY.

1. Yes, I think the big locomotives are satisfactory.

2. I do not think there are any more failures in proportion to number of train miles than when we used the small locomotives.

3. The percentage of engine failures is due to overloading probably more than anything else.

4. Generally speaking, I believe it a good policy to load engines, when business is heavy, light enough so that they can make an average speed over the division of 12 to 15 miles an hour; and, when business is light, increase the load so that you can decrease your train mileage as much as possible.

5. It would depend a great deal as to how many slow trains you had moving as to whether or not the capacity of the road would be limited by time required by slowest train to make distance between side tracks of an average distance of six miles each.

G. L. NOBLE, Assistant General Manager.

X AND Y RAILWAY.

1. I consider big locomotives are, on the whole, satisfactory. I believe we have to adjust our shop and roundhouse work to new conditions and that some of the dissatisfaction with large engines is due to the fact that we did not realize immediately the necessity for this.

2. I believe locomotive failures have increased with the increase in the size of the locomotives, but not necessarily because the locomotives were larger. We did not immediately know how to take care of the large engines and some of their details were far from satisfactory. As defects in design are remedied and better attention is given to the large locomotives, I do not see any reason why these failures should be any greater in proportion to business handled than if the same amount was handled by small engines.

3. The answer to question 2 also answers this question. I do not think failures of large engines are, as a rule, due to overloading.

4. The load which engines should be required to haul, in my opinion, depends upon many matters. As a general policy I should say that your suggestion is right, namely, that when business is light they should be loaded heavily, but when business is heavy the engines should be loaded a little less heavily with a view of getting the maximum amount of freight moved by them in a given time. There can, however, be no fixed rule as to where the line on tonnage shall be drawn. I think it depends a good deal upon character of traffic and physical condition of the road. If one division had a few ruling grades not heavy enough for pusher service it would appear as if at all times the engines should be loaded with the maximum they will take over these grades, for on the other parts of the division they can make good time. On a low grade line the tonnage is seldom fixed by ruling grades, but is based upon the necessity for getting over the division in a reasonable time. The speed which the train shall be required to make under such circumstances may be further complicated by a heavy passenger service, as on our tracks, where we have to load the trains to a tonnage which will enable them to make a pretty high rate of speed while in motion; otherwise they would never get out of the way of passenger trains.

5. I think on a single track line one factor in limiting the capacity of the road is the *average* time required to cover the distance between side tracks. I do not think it is quite correct to say it is limited by the time of the *slowest* trains to make this distance. The number and schedule of passenger trains is also a factor. On a double-track railroad the time between side tracks will be a large factor or a small, and depend upon several other conditions; as for instance: The number and schedule of passenger trains, and the character of the freight traffic. If there were no passenger trains and all freight traffic was of a uniform character, and all trains could travel at the same speed, there would be no need for side tracks except to get out of the procession such trains as were in trouble, but with a large variety of freight traffic, some of it traveling at high speeds and some of it at slow speeds, freight trains must pass each other. A great many railroads are finding out that the limit of capacity of their roads is not so much due to the physical conditions between terminals as to the limits at terminals. Generally speaking, our terminals are not large enough and trains cannot be handled promptly upon arrival. This results in holding out trains, with the consequent loss of time of engines and also a congestion in the yards, which frequently involves serious loss of time in getting engines and their trains out of the terminals.

——————, General Manager.

———— ———— RAILROAD.

1. In a general way we believe that they are, when they can be loaded to their capacity. By large locomotives we refer to freight locomotives weighing not over 200,000 lbs, preferably of the consolidation type. We have had no experience with heavier ones. We do not consider these locomotives to be satisfactory where they are run much underloaded or at high speeds.

2. The wear of such locomotives is naturally much greater than that of the smaller ones which preceded, owing to the increasing weight of the parts; and owing to the great weight of the locomotives and of the parts forming them, the existing roundhouse organizations are less capable of making the small repairs, which, if neglected, require greater repairs. In addition to this, the tires and such parts with the heavier wheel loads give less life in service than did the lighter locomotives.

3. Probably to the first cause, rather than to the latter. In comparison to the tractive power, we should say that the large locomotives are not generally overloaded to the same extent that the smaller ones were.

4. We think that the conditions mentioned are not the governing ones. When the business is heavy it is very frequently unbalanced in direction from day to day, requiring light or partly loaded movements one way in order to balance the power. We think that this question will also be locally affected by the nature of the road and the number of tracks, and the same answer would probably not apply to single or double-track roads and those having more than two tracks.

— — ————, General Manager.

STEEL CAR DEVELOPMENT.

PENNSYLVANIA RAILROAD.

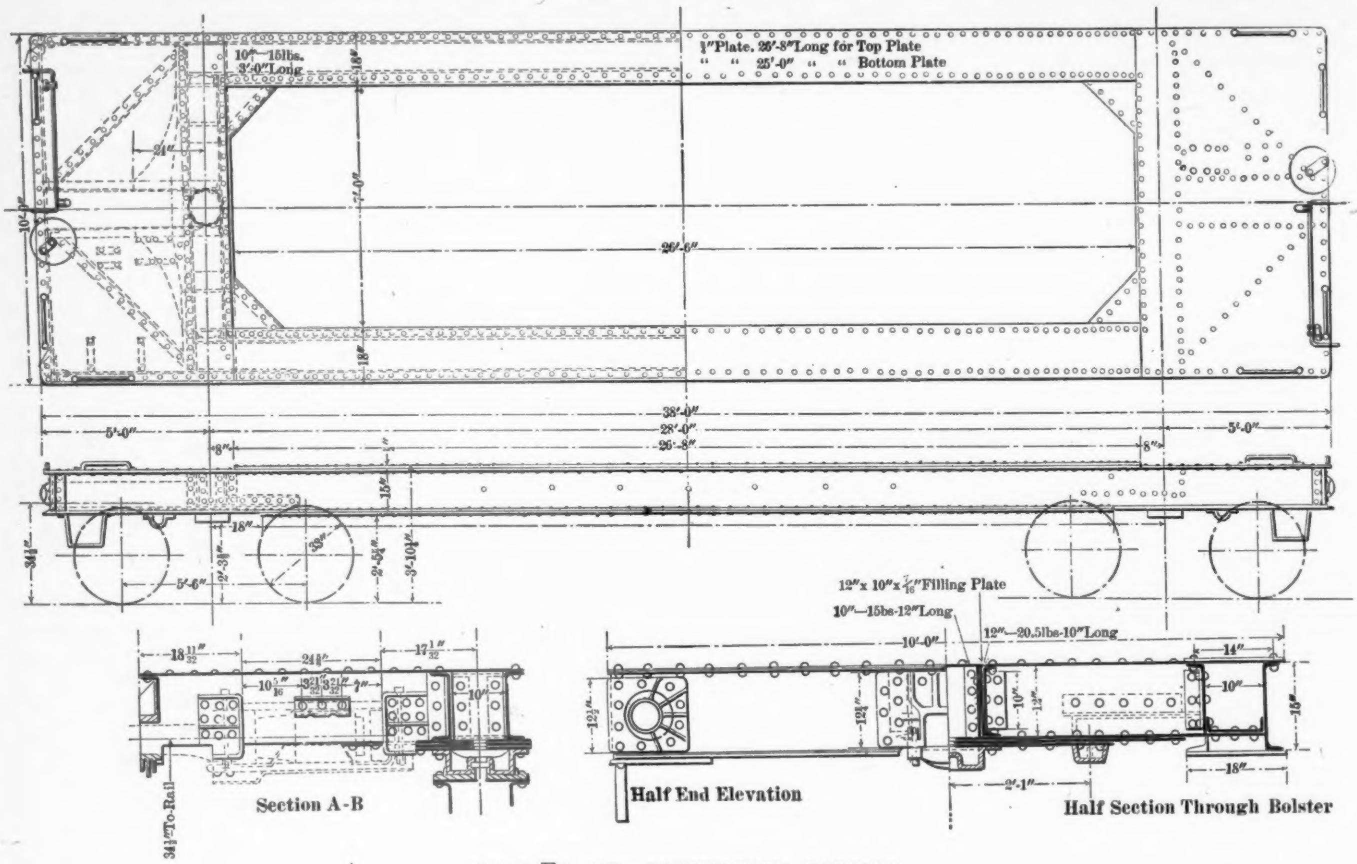
V.

(For previous article see page 3, January, 1904.)

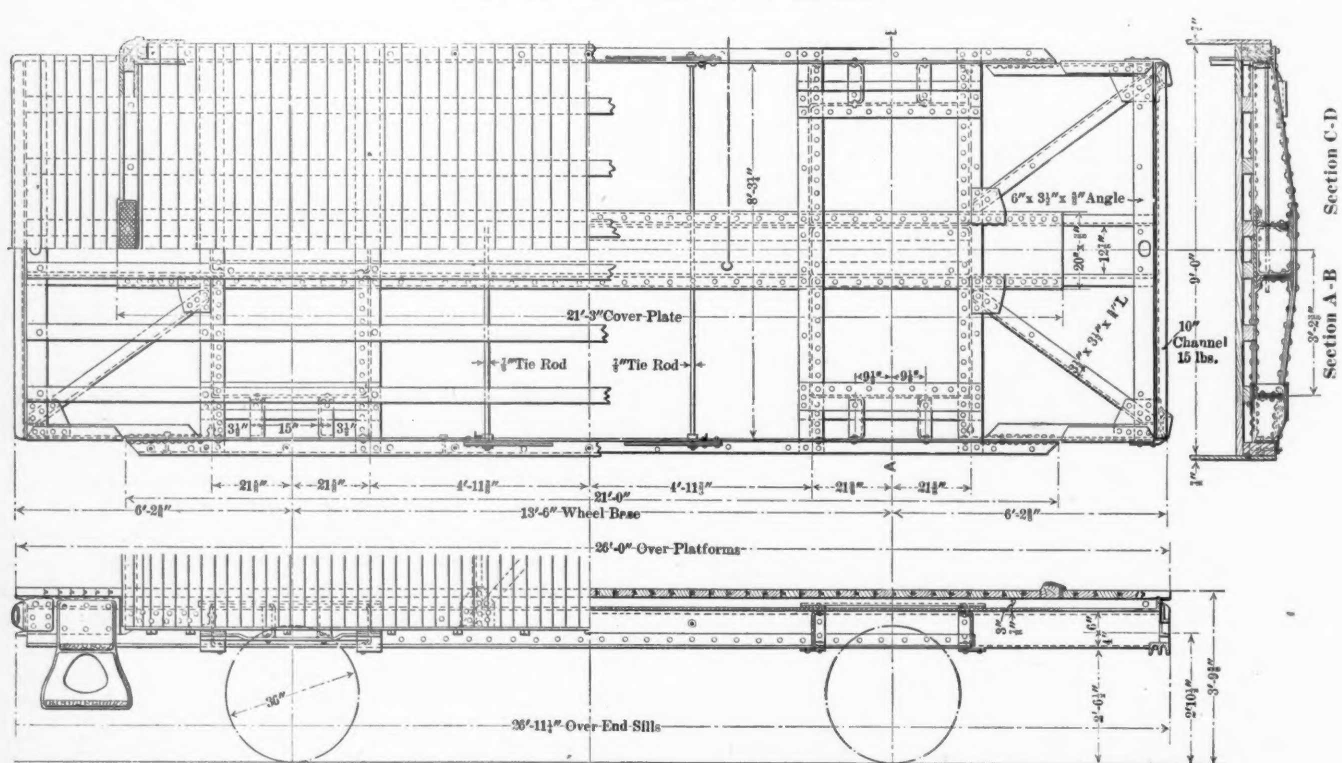
While it is out of chronological order, the special steel car known as class FN is the next design to be described. This is a flat car built entirely of steel and has a carrying capacity of 100,000 lbs., the car weighing 34,800 lbs. It was specially designed for use in transporting large castings and electrical machinery, the floor of the car having a large opening through which the load may extend downward in order to come within clearance dimensions. This car is designed to carry the entire load, if necessary, concentrated within 4 ft. of each side of the center, or a distance of 8 ft. along the length of the car at the center. If a load is carried outside of this distance it may be 120,000 lbs.

The bolsters are connected by two box girders, one on each side, of 15 in. channels with ¾ in. cover plates 18 ins. wide, extending the full length of the opening. The bolsters are of 12 in. channels in pairs, with three bottom cover plates of different lengths and one top cover plate. The upper of the three bottom cover plates extends the full width of the car and the box girders are reinforced at the bolsters by short pieces of 10 in. channels laid flat. The upper of these three bolster cover plates extends towards the end of the car in the form of two gussets, which are cut away at the center to give room for the draft gear. The drawings show the corner bracing of the car and the heavy gusset bracings at the corners of the central opening.

The end sills are of 15 in. channels cut out for the coupler shanks and the openings reinforced by steel castings. The deck plates at the ends of the car form top cover plates for the bolsters. This car is mounted upon 100,000 lbs. capacity trucks. It is fitted with Westinghouse friction draft gear, the draft gear car, it having been found necesssary to strengthen the entire frames of cabin cars which are used in severe pushing service. This frame has a backbone of 10 in.-25 lb. channels, with a cover plate on top only and reinforced at the bottom by 3½x3½x⅜ in. angles. The cover plate extends beyond the



CLASS FN CAR.—PENNSYLVANIA RAILROAD.



STEEL UNDERFRAME FOR CLASS ND CAR.—PENNSYLVANIA RAILROAD.

stops being held by nine rivets, a construction which has proved sufficient in service. This is a remarkably strong car and it has been in demand for special service, particularly for carrying large electric generators.

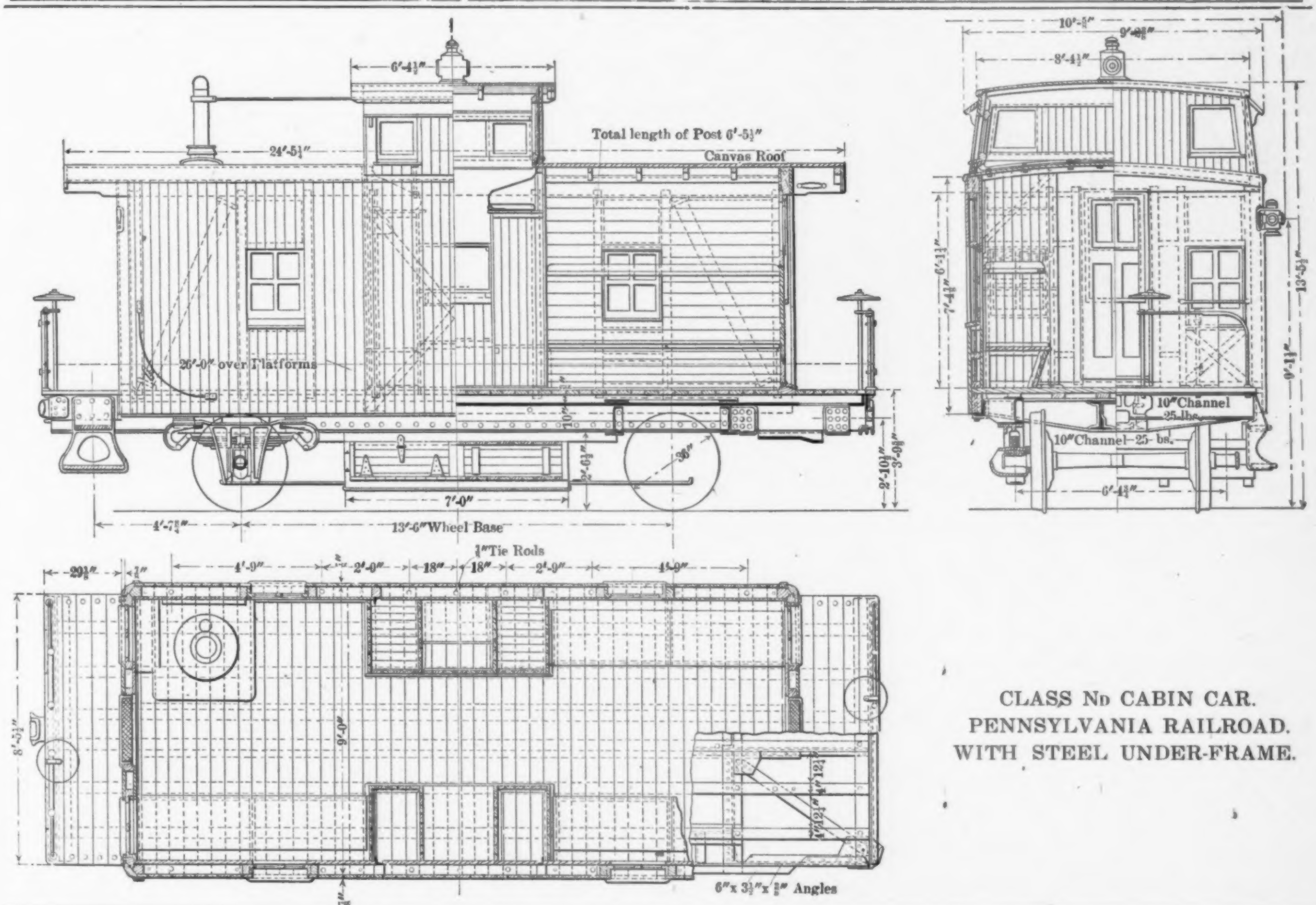
The other car described is the Class ND, cabin car.

Steel construction has been employed in the framing of this bolsters at each end to within a short distance of the end sills The end sills are of 10 in. channels. The side sills are 6x3½x⅜ in. angles, extending almost to the end of the car, where they are continued by shorter pieces of angles reaching to the end sills. The transoms are built up of three pressed diaphragms, of which there are two at each end of the car

They have 6½x½ in. top and bottom cover plates. The pedestals are bolted to girders of the form of presssed steel diaphragms extending between the transoms, with top and bottom cover plates, forming footings for the pedestal castings.

The car is really an elongated four-wheeled truck with a house built on it. The steel frame carries 4x8 in. side sills and six nailing strips on which the house is built. The drawing of the frame shows the corner bracing angles to receive poling thrusts from the corner castings. Two ⅞ in. tie rods hold the light side sill angles together near the center of the car and these have nuts inside and outside of the side sill angles.

The central portion of the house is built over a steel frame riveted to the side sills, which serves to stiffen the cupola. It has diagonal braces and steel carlines of angles. The diagonals are of 3x⅜ in. flat steel. The cupola is braced by bent angles secured to the roof of the car and extending up the side walls, stiffening this part of the structure. The wheel base of the car is 13 ft. 6 in. Its coupled length is 277 ft. 10¼ in. The wheels are 36 in. in diameter. The car weighs 28,000 lbs. This cabin car is somewhat larger than has been used on this road previously, and affords more comfortable quarters for the men, who frequently live for some days at a time in the cars. This car has proved to be entirely satisfactory and capable of withstanding the force exerted by two class H6 locomotives pushing against it, and these are the heaviest freight locomotives on the road.



CLASS ND CABIN CAR.
PENNSYLVANIA RAILROAD.
WITH STEEL UNDER-FRAME.

VAUCLAIN 4-CYLINDER BALANCED COMPOUND.

4-4-2 TYPE PASSENGER SERVICE.

CHICAGO, BURLINGTON & QUINCY RAILWAY.

In this journal in March, 1902, page 72, was illustrated the first four-cylinder balanced compound built by the Baldwin Locomotive Works, and in June, 1903, page 210, the construction of the further development of this type, as built for the Atchison, Topeka & Santa Fe, was presented. The present engravings show the construction of another example which is now being completed by the Baldwin Locomotive Works for the Chicago, Burlington & Quincy Railway, but has not yet been put into service. This locomotive embodies the principles of the other two designs which have been mentioned, and especially arranged, in the matter of detail, to meet the conditions of the Burlington. The following indicate some of the leading differences between the Burlington and Santa Fe designs:

	Burlington.	Santa Fe.
Diameter of driving wheels	78 ins.	78 ins.
Weight on drivers	100,000 lbs.	90,000 lbs.
Total weight	192,000 lbs.	187,000 lbs.
Total heating surface	3,216.9 sq. ft.	3,029 sq. ft.
Grate area	44.14 sq. ft.	49.4 sq. ft.
Largest diameter of boiler	64 ins.	66 ins.
Length of tube	19 ft.	18 ft. 1 in.

This indicates that with the same size cylinders, 15 and 25x26 in. in both engines, the tractive effort of the Burlington is less than that of the Santa Fe, the tractive effort of the former being 21,400 lbs., whereas that of the latter is 24,000 lbs. in compound working for both cases. In the Burlington design advantage is taken of the balancing of the reciprocating parts in order to increase the weight on driving wheels, which, in this case, is made 100,000 lbs., a rather unusual weight for four wheels, except on the Pennsylvania. It should be stated that the weights of the Burlington engine are estimated at the time of writing, the locomotive not having been completed. This engine has outside journals for the trailing wheels, the construction of the frames being the same as that illustrated on page 119 of our April number, 1902. The crank axles are forged, and 4½ in. pins are forced in through the crank pin portions. The crank cheeks are banded by tire steel hoops, finished all over, then heated, bent to shape and shrunk on. The following ratios and list of dimensions will be convenient for record:

VAUCLAIN BALANCED COMPOUND PASSENGER LOCOMOTIVE.

4—4—2 TYPE—C., B. & Q. R. R.

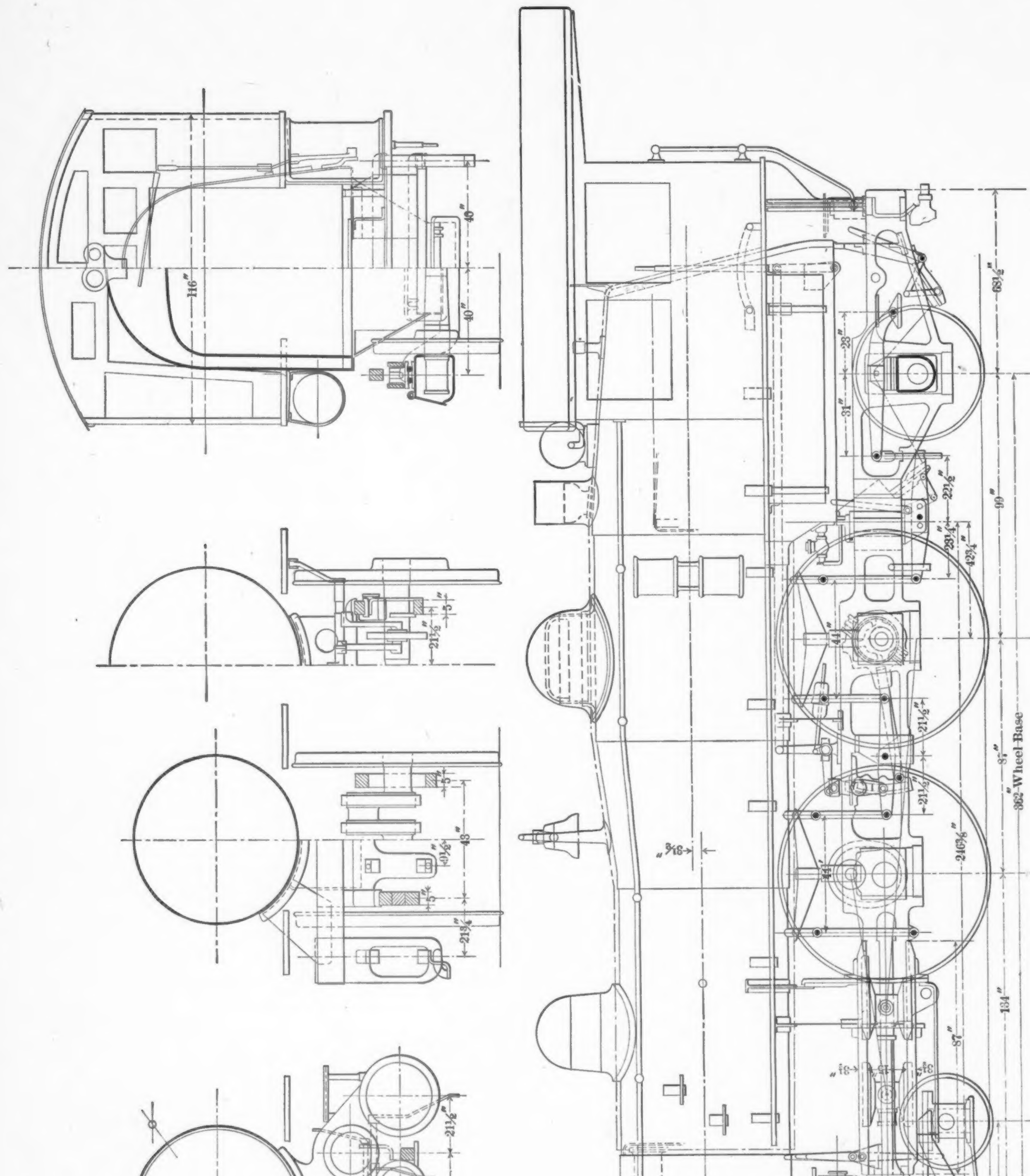
RATIOS.

Heating surface to volume of high-pressure cylinders	606.9
Tractive weight to heating surface	31.08
Tractive weight to tractive effort	4.67
Tractive effort to heating surface	6.65
Heating surface to grate area	72.88

Heating surface to tractive effort 15.03%
Total weight to heating surface 59.68
Tractive effort × diameter of drivers to heating surface 518.8

GENERAL DIMENSIONS.

Gauge .... 4 ft. 8½ ins.
Cylinders .... 15 ins. and 25 ins. x 26 ins.
Valves .... Balanced piston
Boiler—Type .... Wagon top
 Diameter .... 64 ins.
 Thickness of sheets .... 11-16 in. and ¾ in.
 Working pressure .... 210 lbs.
 Fuel .... Soft coal
 Staying .... Radial
Firebox—Material .... Steel
 Length .... 96⅛ ins.
 Width .... 66¼ ins.
 Depth .... Front, 70⅝ ins.; back, 68⅜ ins.
 Thickness of sheets:
  Sides, ⅜ in.; back, ⅜ in.; crown, ⅜ in.; tube, ½ in.
 Water space .... Front, 4 ins.; sides, 4 ins.; back, 3 ins.
Tubes—Material .... Iron
 Wire gauge .... No. 11
 Number 274
 Diameter .... 2¼ ins.



BALDWIN LOCOMOTIVE WORKS, *Builders.*

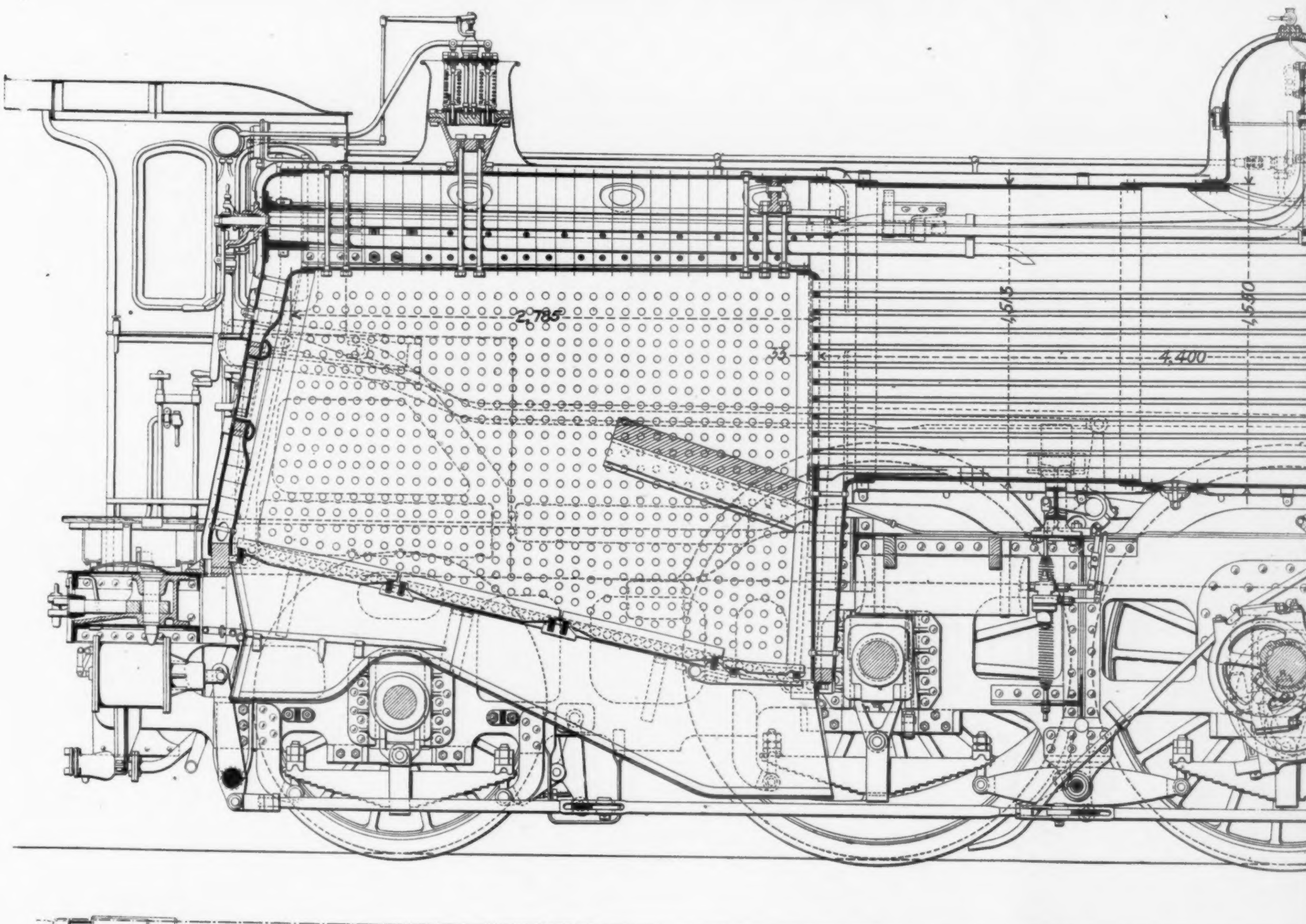
VAUCLAIN 4-CYLINDER BALANCED COMPOUND PASSENGER LOCOMOTIVE.

CHICAGO, BURLINGTON & QUINCY RAILWAY.

(For description see page 211.)

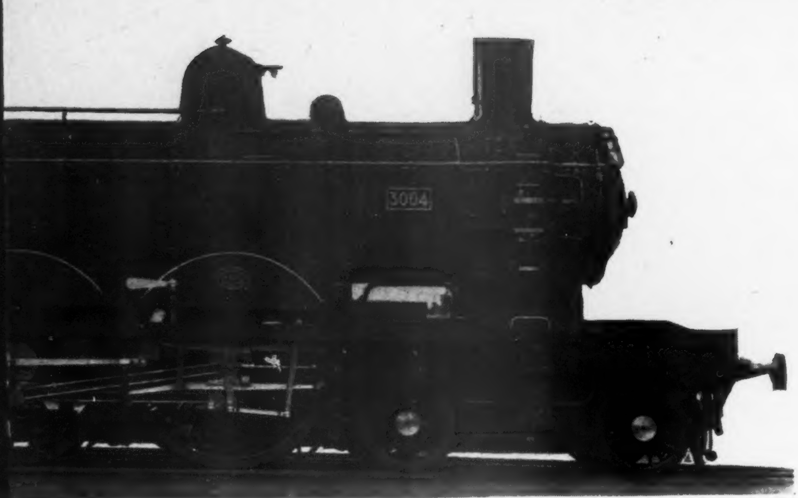
F. H. CLARK, *Superintendent Motive Power.*

PARIS-ORLEANS LOCOMOTIVE No. 3004.

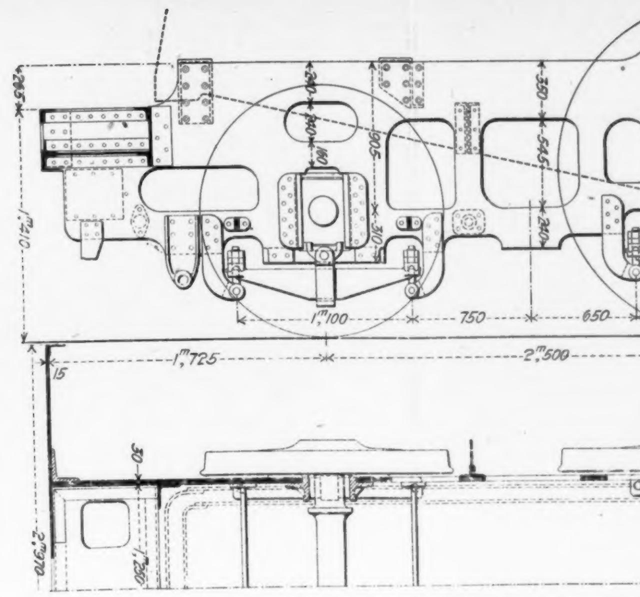


LONGITUDINAL SECTIONS THROUGH BOILER AN

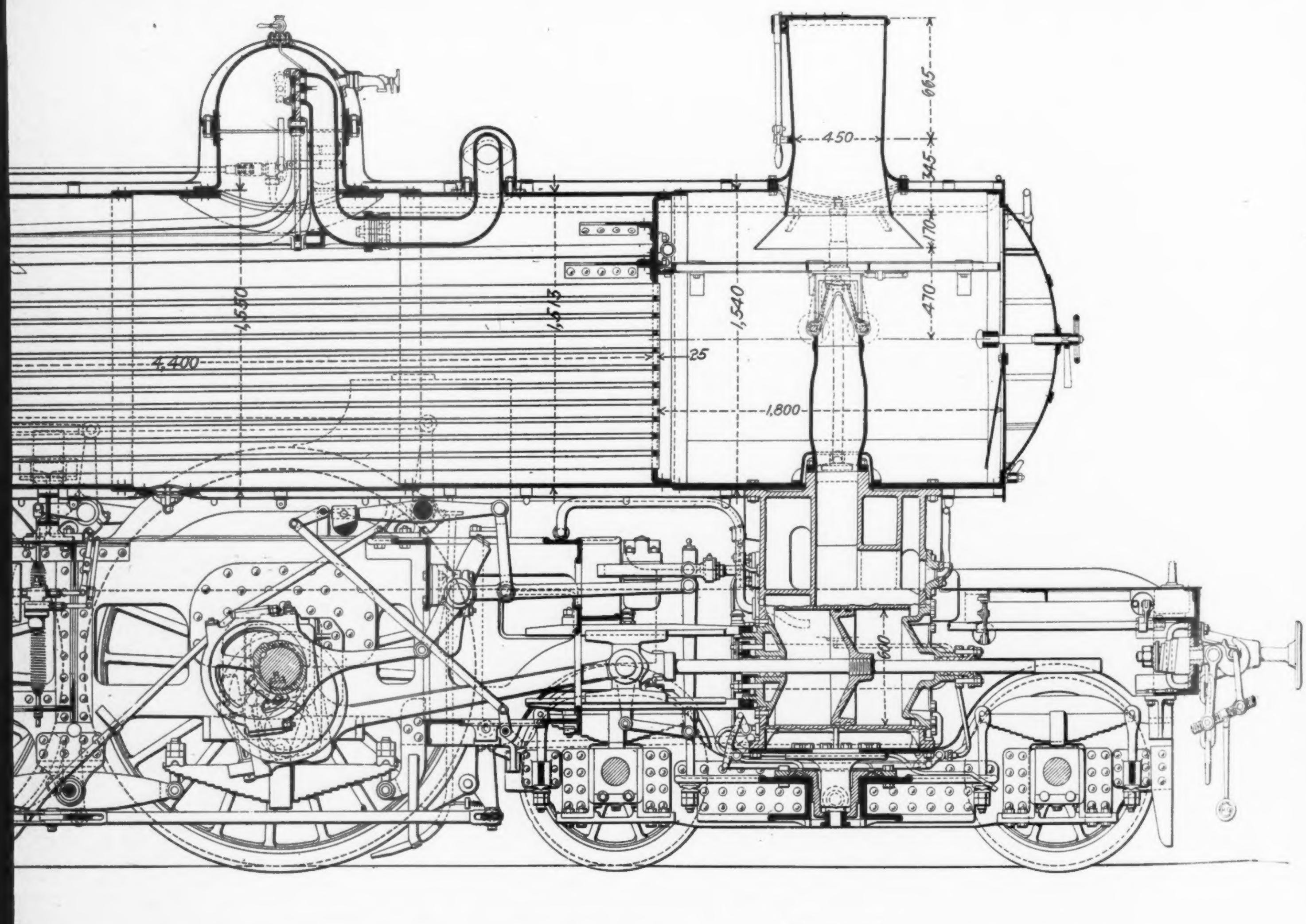
1904.



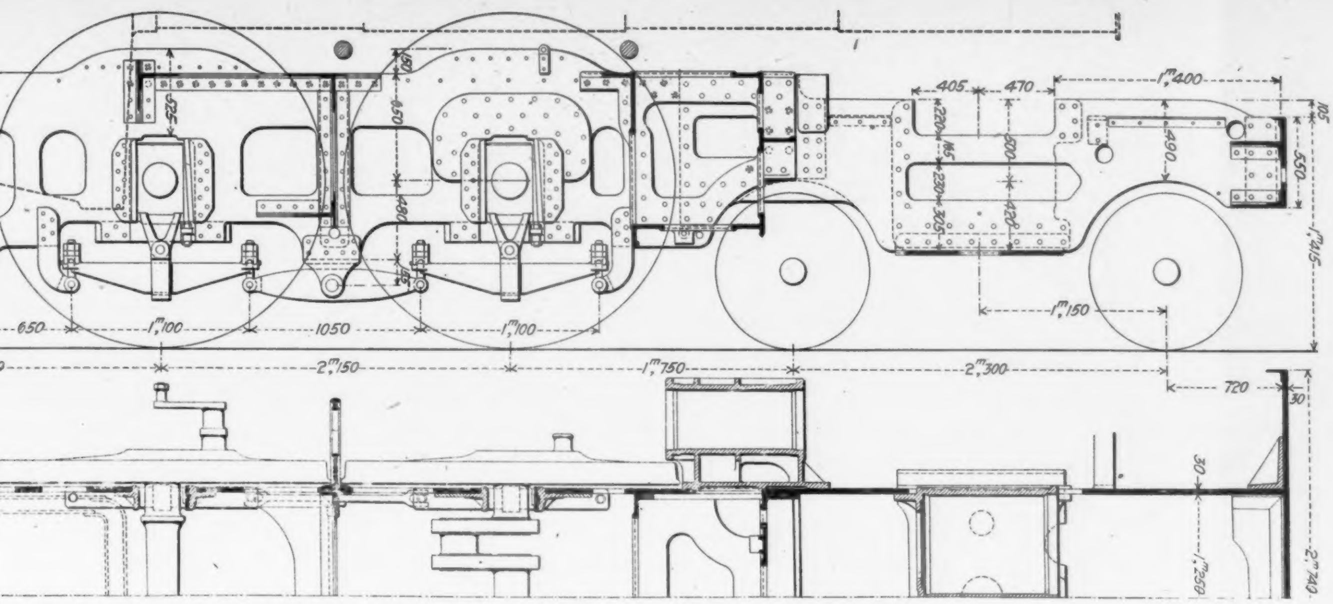
3004.



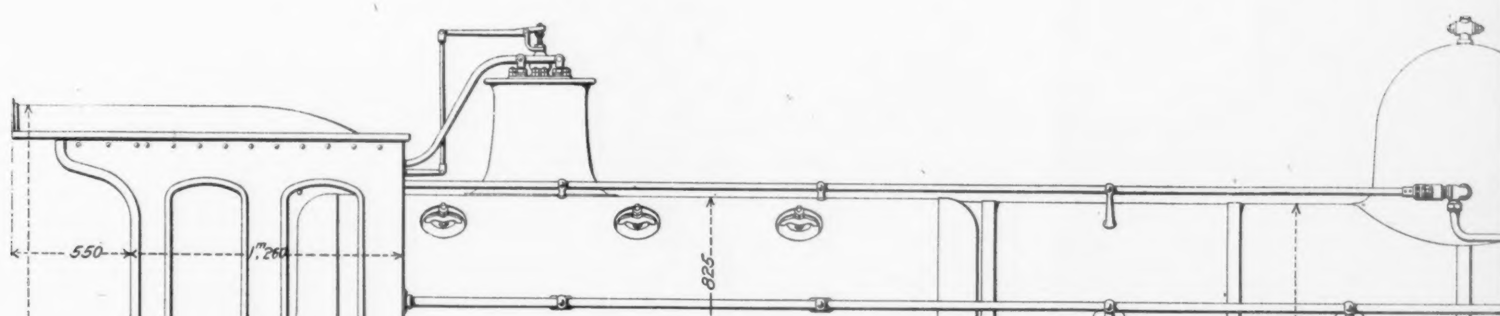
LONGITUDINAL SECT



CTIONS THROUGH BOILER AND RUNNING GEAR.



L SECTIONS THROUGH FRAMES SHOWING PLATE FRAMES AND FRAME BRACING.



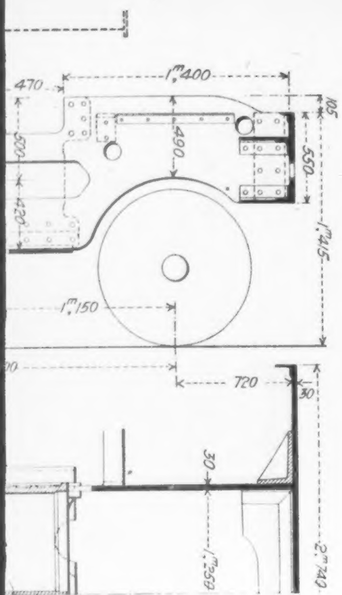
DE GLEHN FOUR-CYLINDER BALANCED CO

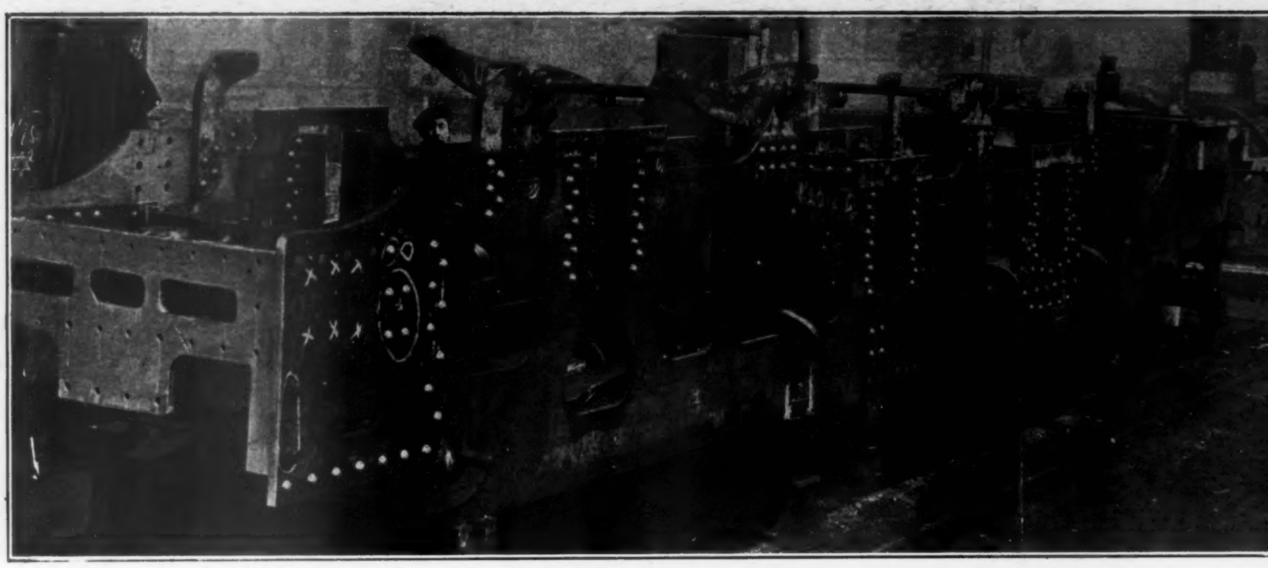
Paris-Orleans Railway. M. M. E. Solacroup, Ingenieur-en-Chef.

Illustrated from drawings received from Mr. A. G. de

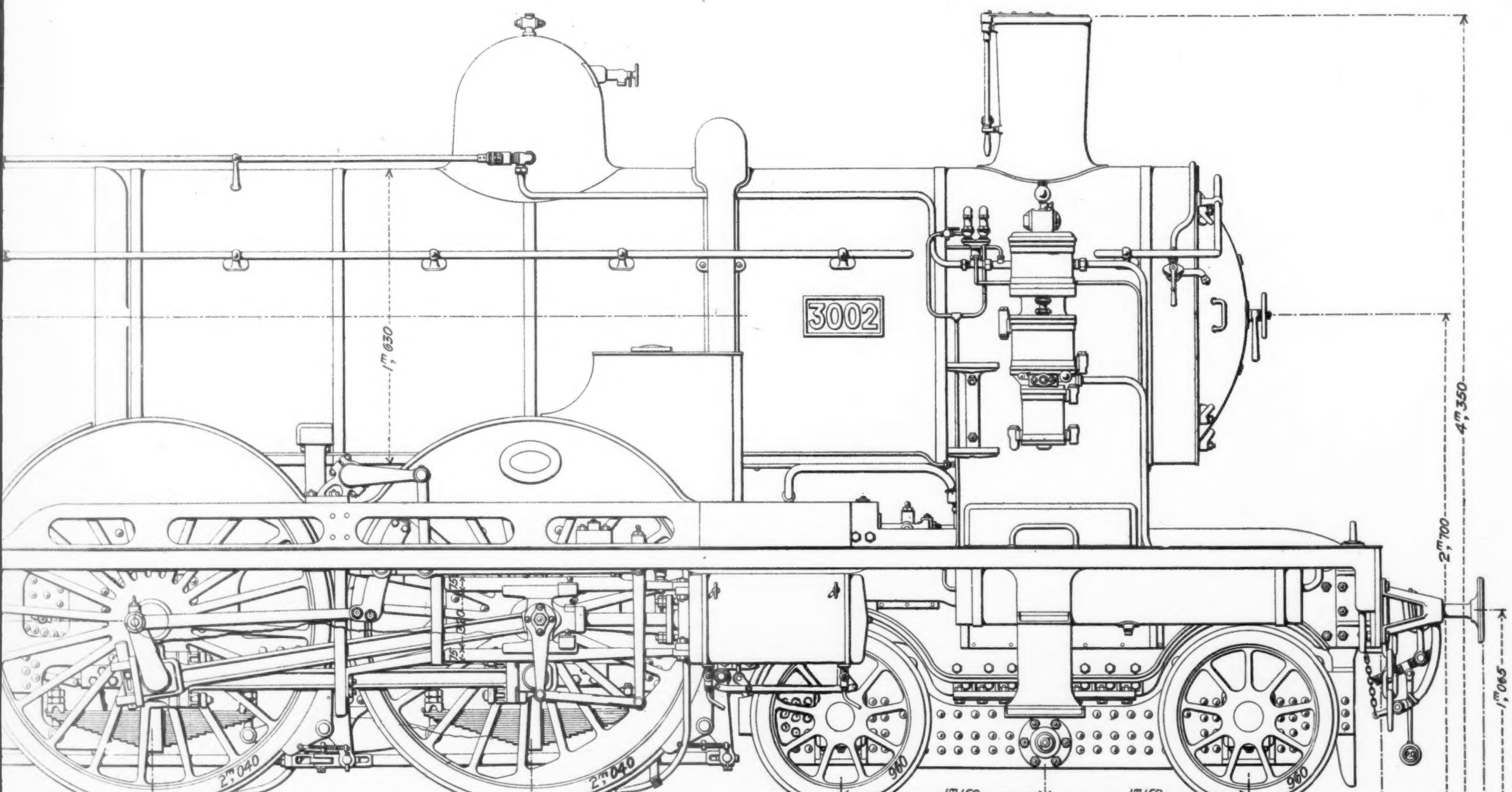
The de Glehn Compound of the Pennsylvania Railroad

This Locomotive will be tested on the Pennsylvania Testing





FROM A PHOTOGRAPH OF FRAMES DURING CONSTRUCTION.



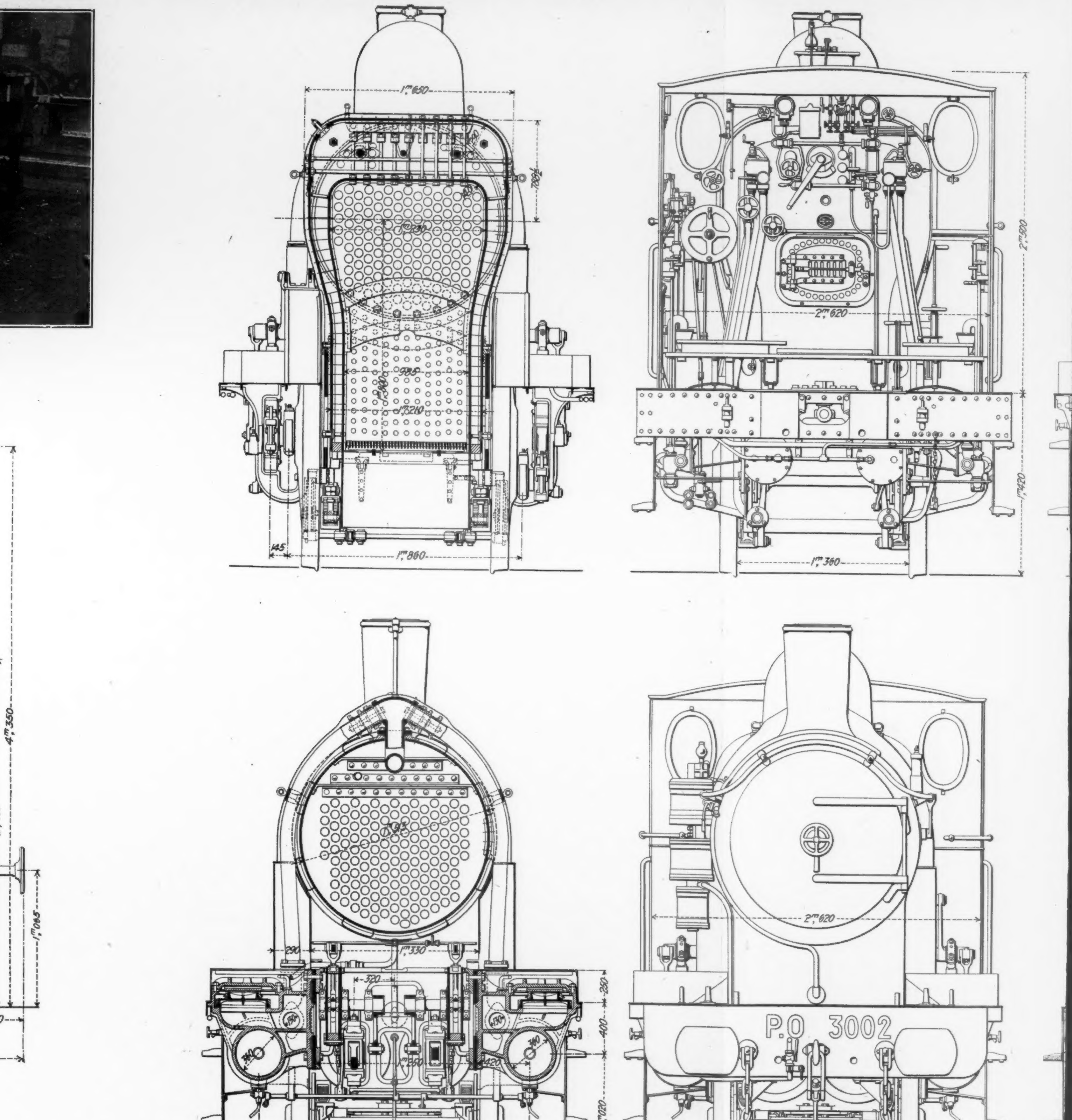
DE GLEHN FOUR-CYLINDER BALANCED COMPOUND LOCOMOTIVE.

-Chef. Societe Alsacienne de Constructions Mechaniques, *Builders.*

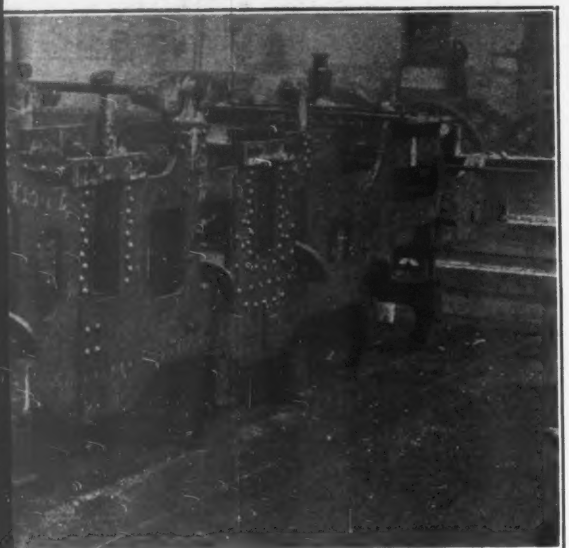
Illustrated from drawings received from Mr. A. G. de Glehn, Mulhouse, Germany.

de Glehn Compound of the Pennsylvania Railroad was built from these drawings.

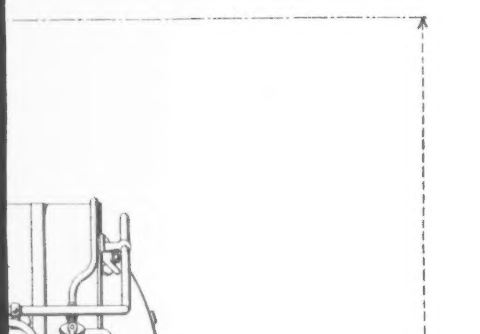
Locomotive will be tested on the Pennsylvania Testing Plant at the St. Louis Exposition.



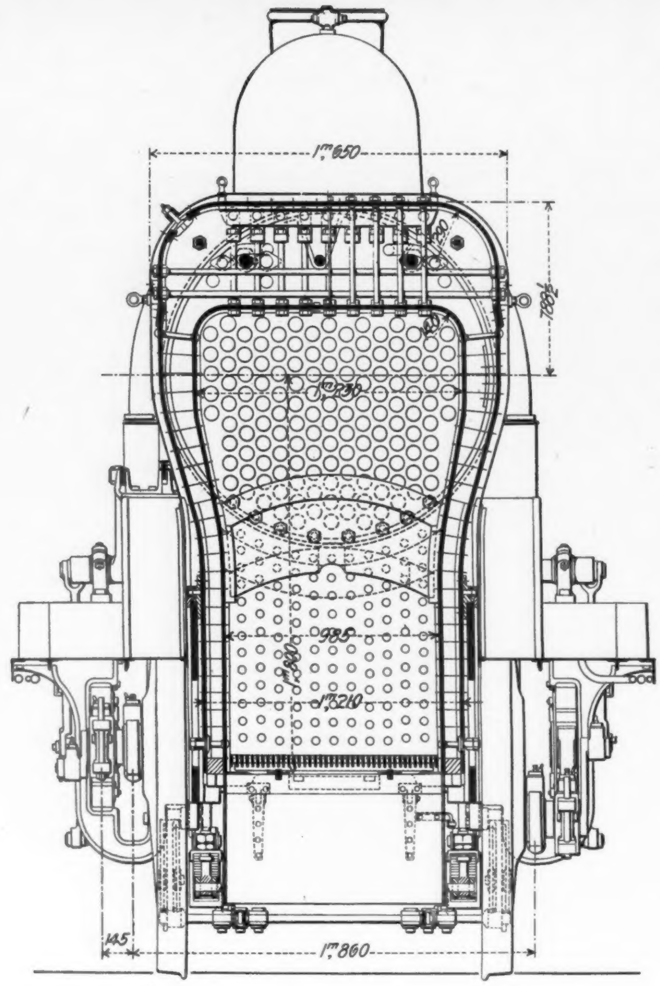
TRANSVERSE SECTIONS AND END VIEWS.

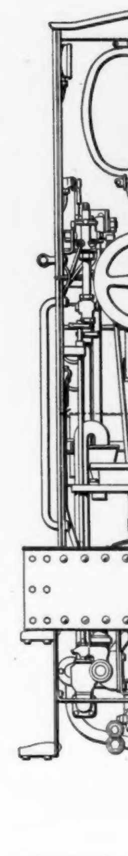


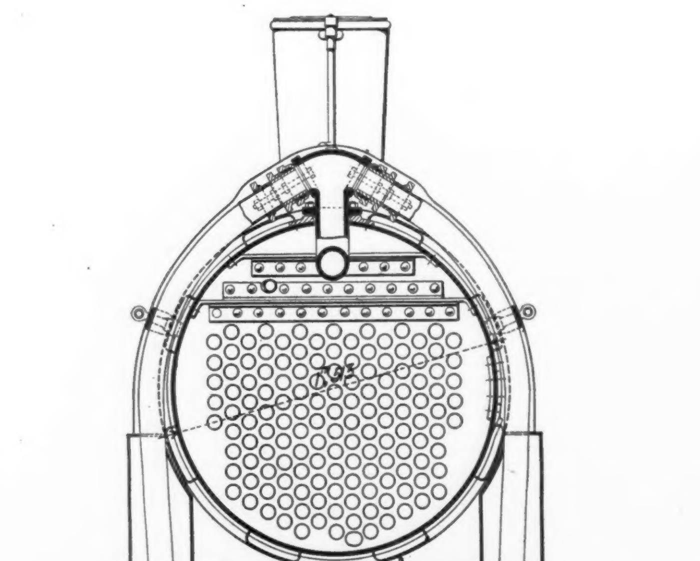
ING CONSTRUCTION.

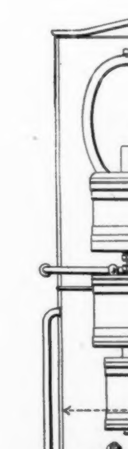


uctions Mechaniques, *Builders.*

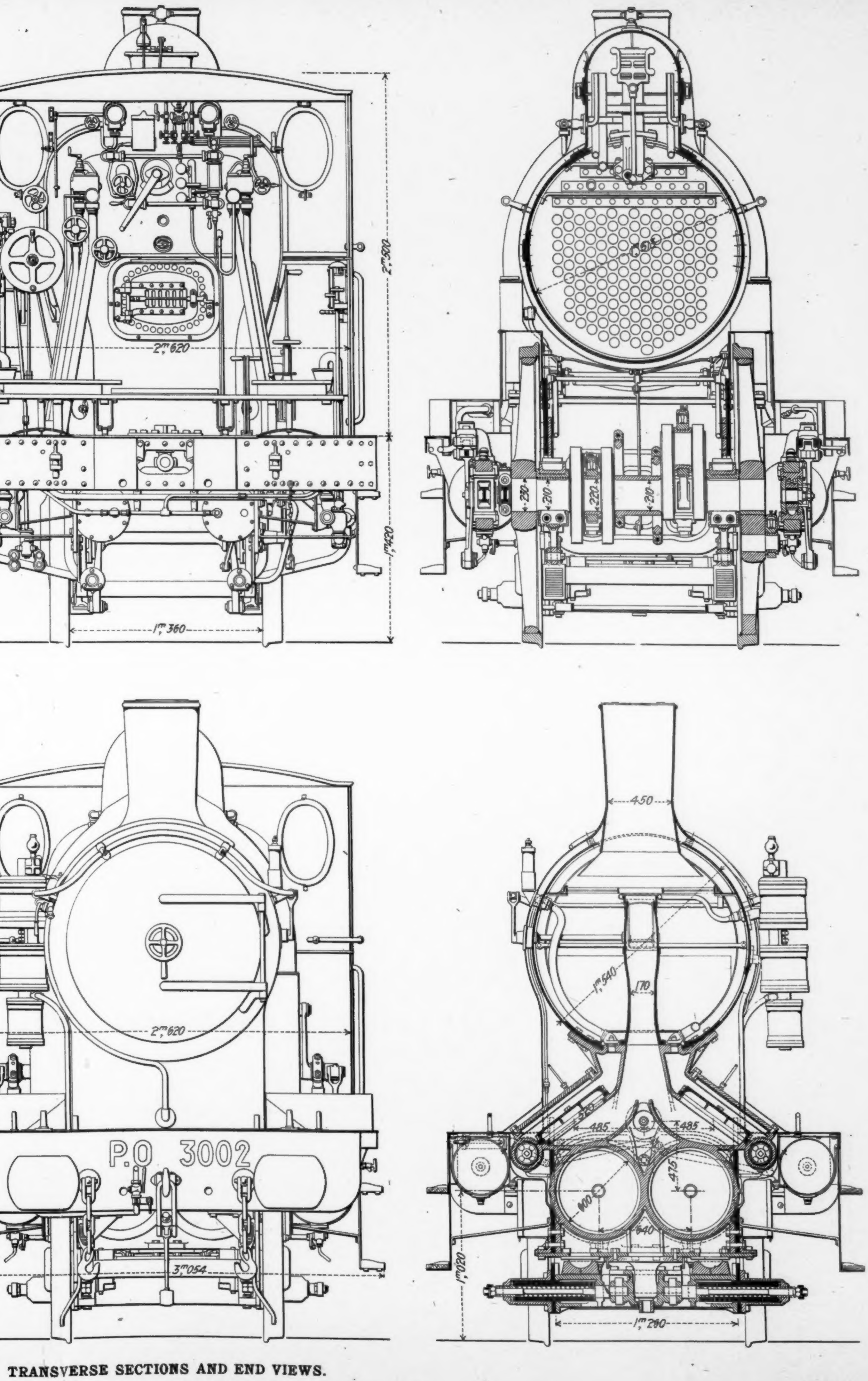






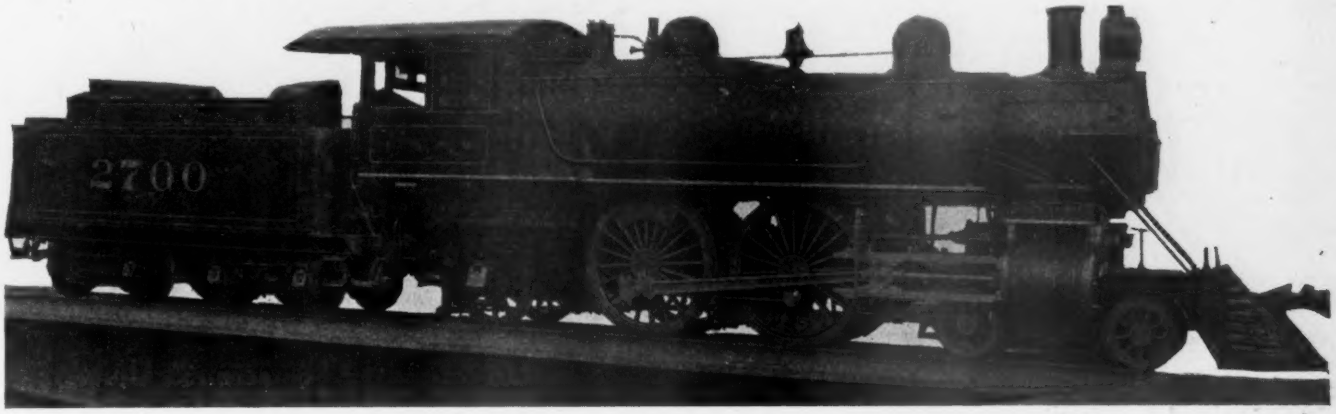


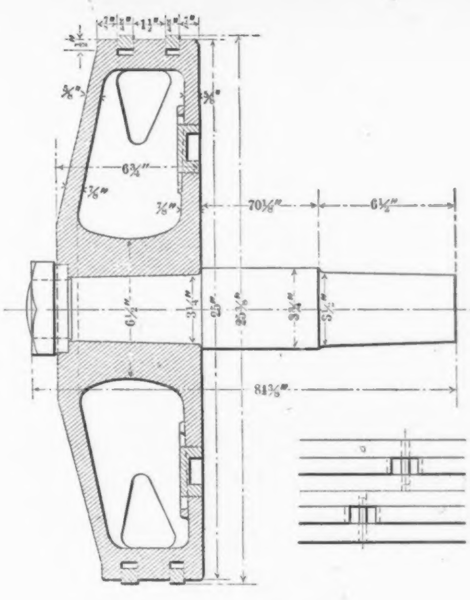
TRA



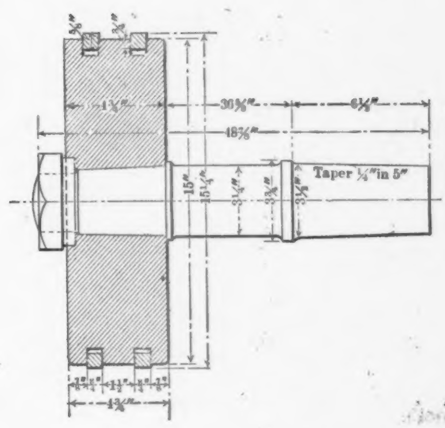
TRANSVERSE SECTIONS AND END VIEWS.

Length	19 ft.
Heating Surface—Firebox	166.4 sq. ft.
Tubes	3,050.5 sq. ft.
Total	3,216.9 sq. ft.
Grate area	44.14 sq. ft.
Driving Wheels—Diameter outside	78 ins.
Diameter of center	70 ins.
Journals	Front, 10 x 10½ ins.; back, 9½ x 12 ins.
Engine Truck Wheels (Front)—Diameter	33 ins.
Journals	6 x 10 ins.
Trailing Wheels—Diameter	48 ins.
Journals	8 x 12 ins.
Wheel Base—Driving	7 ft. 3 ins.
Rigid	15 ft. 6 ins.
Total engine	30 ft. 2 ins.
Weight—On driving wheels	100,000 lbs.
On truck, front	50,000 lbs.
On trailing wheels	42,000 lbs.
Total engine	192,000 lbs.
Total engine and tender	312,000 lbs.
Tank—Capacity	6,000 gals.
Tender—Wheels	Number, 8; diameter, 37¼ ins.
Journals	5 x 9 ins.
Service	Passenger

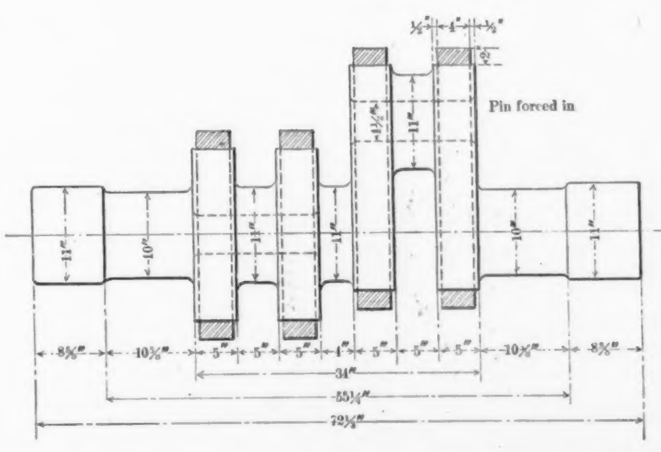


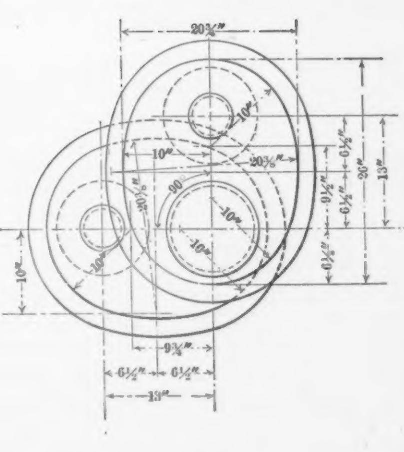


LOW-PRESSURE PISTON.



HIGH-PRESSURE PISTON.





CRANK AXLE SHOWING BANDING.

VAUCLAIN 4-CYLINDER BALANCED COMPOUND PASSENGER LOCOMOTIVE.

CHICAGO, BURLINGTON & QUINCY RAILWAY.

F. H. CLARK, *Superintendent Motive Power.* BALDWIN LOCOMOTIVE WORKS, *Builders.*

(For description see page 211.)

THE APPLICATION OF INDIVIDUAL MOTOR-DRIVES TO OLD MACHINE TOOLS.

BY R. V. WRIGHT, MECHANICAL ENGINEER.

XI.

PLANERS AND SHAPERS.

McKEES ROCKS SHOPS.—PITTSBURGH & LAKE ERIE RAILROAD.

Four of the planers that were used in the old shops at McKees Rocks were transferred to the new machine shop, and have been equipped with variable speed motor drives. These planers are called upon to handle quite a large variety of work, and on this account it was thought advisable to have them fitted so that the cutting speed could be varied. It did not, however, seem desirable to change the speed of the cutting stroke to any great extent by reducing the speed of the motor, since the speed of the return stroke would be reduced at the same time.

The belt driven type of planer has ordinarily only one cutting speed, and this is, of course, designed to suit average condi-

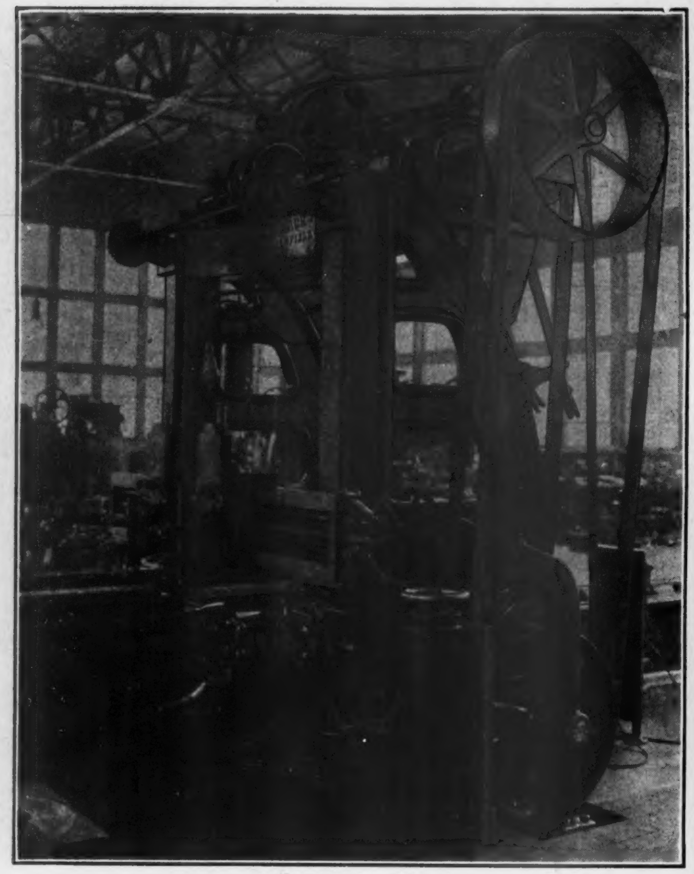


FIG. 52.—THE APPLICATION OF VARIABLE-SPEED MOTOR DRIVING TO THE 60-IN. POND PLANER, WITH SPECIAL GEAR CHANGES FOR 20 AND 30 FT. CUTTING SPEEDS.

tions. There are many cases where different cutting speeds could be used to advantage, but there is no reason why, if it is possible to provide it, a constant speed for the return stroke should not be used for all cutting speeds. The speed of the return stroke should, of course, be made as high as possible, and will depend on the design of the tool, the weight of the shifting pulleys, etc. Generally speaking, the shifting belts should not have a maximum speed of more than 4,000 ft. per minute. With higher speeds the weight of the pulleys will cause the bed to move too far, and the belts will wear out quite rapidly.

In some cases the speed of the return stroke in an old planer cannot be increased very much unless wider shifting belts are used, and this means that the shifting mechanism will have to be redesigned. The gearing must also be checked over, and in some cases cast iron gears may have to be changed to cast steel.

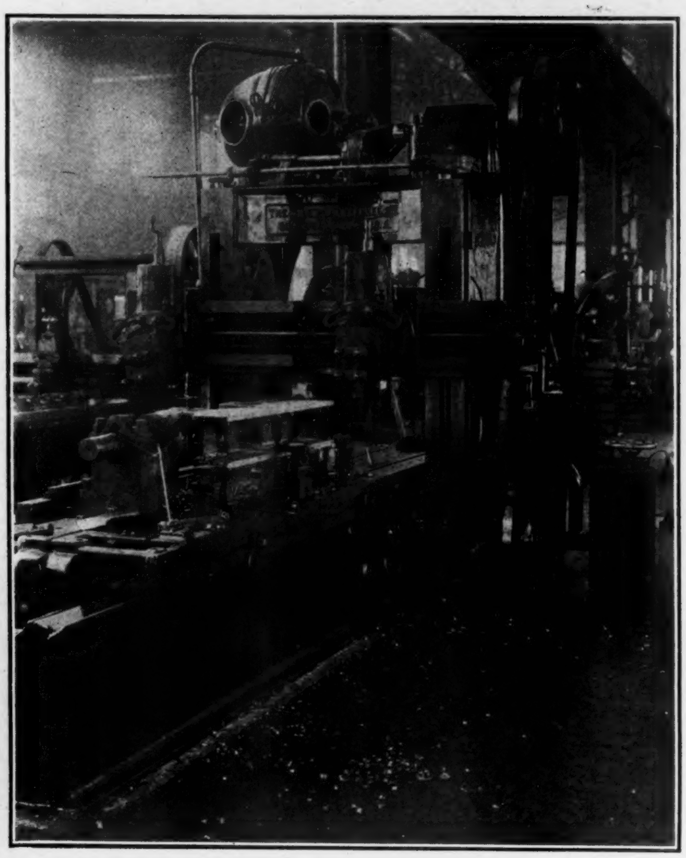


FIG. 53.—THE APPLICATION OF A VARIABLE-SPEED DRIVE TO THE 42-IN. CINCINNATI PLANER, WITH SPECIAL GEAR BOX GIVING CUTTING SPEEDS OF 15, 20, 25 AND 30 FT. PER MIN.

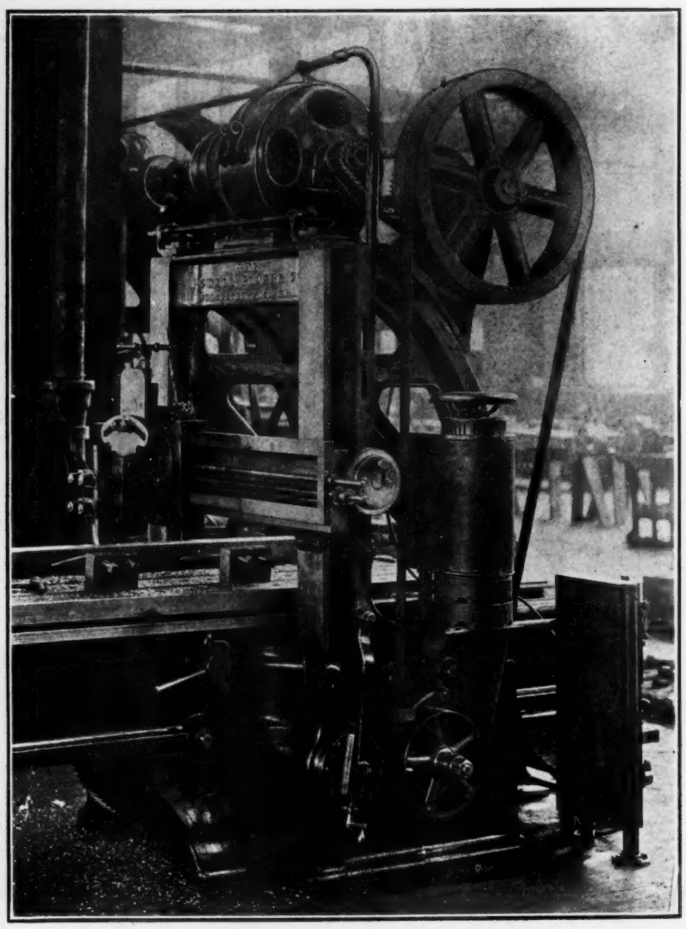


FIG. 54.—THE CHAIN DRIVE UPON THE 30-IN. POWELL PLANER, SHOWING CONVENIENT ARRANGEMENT OF CONTROLLER.—7½-H.-P. CROCKER-WHEELER MOTOR.

On one of our planers, a 60-in.x60-in.x20ft. Pond planer (Fig. 52), we have arranged for cutting speeds of 20 and 30 ft. per minute, with a return speed of 60 ft. per minute. Cutting speeds below 20 ft. per minute, and from 30 down to 20 ft. per minute, can be obtained by varying the speed of the motor, but the speed of the return stroke will, of course, in such cases, be changed at the same time.

The motor which drives this planer is, as shown in the engraving, carried on a cast iron table, which is supported by two brackets bolted to the housings. The motor armature shaft was extended by coupling on a piece of shafting, and on the end of this shaft was keyed a fly-wheel, which is also used as a pulley for the belt for the return stroke. A countershaft was added, which carried the pulley for driving the cutting stroke, and this countershaft can be driven from the motor-shaft by either one of two runs of gearing; change from one run of gearing to the other is made by means of a substantial jaw-clutch. The shifting belts were increased to 4 in. in width and the cast iron running parts were changed to steel.

The controller is, in this case, placed on the floor to the right of the tool and in front of the shifting mechanism, where it is within easy reach of the operator. The planer is driven by a Crocker-Wheeler 20-H.-P. compound-wound multiple-voltage motor, in connection with a type 80-M.F. controller, giving 18 speed changes.

The following data will give some idea of the power required to operate this tool. A roughing cut was taken by two round-nose tools on some mild-steel locomotive guide bars. The bars were tapered slightly toward the ends, and the heaviest cut, which was 5-16 of an in. full, was taken near the middle of the bar. The feed was 7-32 of an in. The power required in cutting varied from about 16-H.-P. at the ends of the guides to 25.6-H.-P. at the middle. The reversal from the cutting stroke to the return required 29-H.-P.; moving the platen on the return, 8.2-H.-P.; and the reversal after the return, 20.7-H.-P. When running light, 6.4-H.-P. was required to move the platen on the forward stroke.

The cutting speed throughout these trials was about 23½ ft. per minute, and the speed of the return stroke 50 ft. per minute. Although the controller was set at point No. 19, at which the nominal power of the motor is about 16-H.-P., no trouble was experienced in carrying the above overload as it was, of course, intermittent.

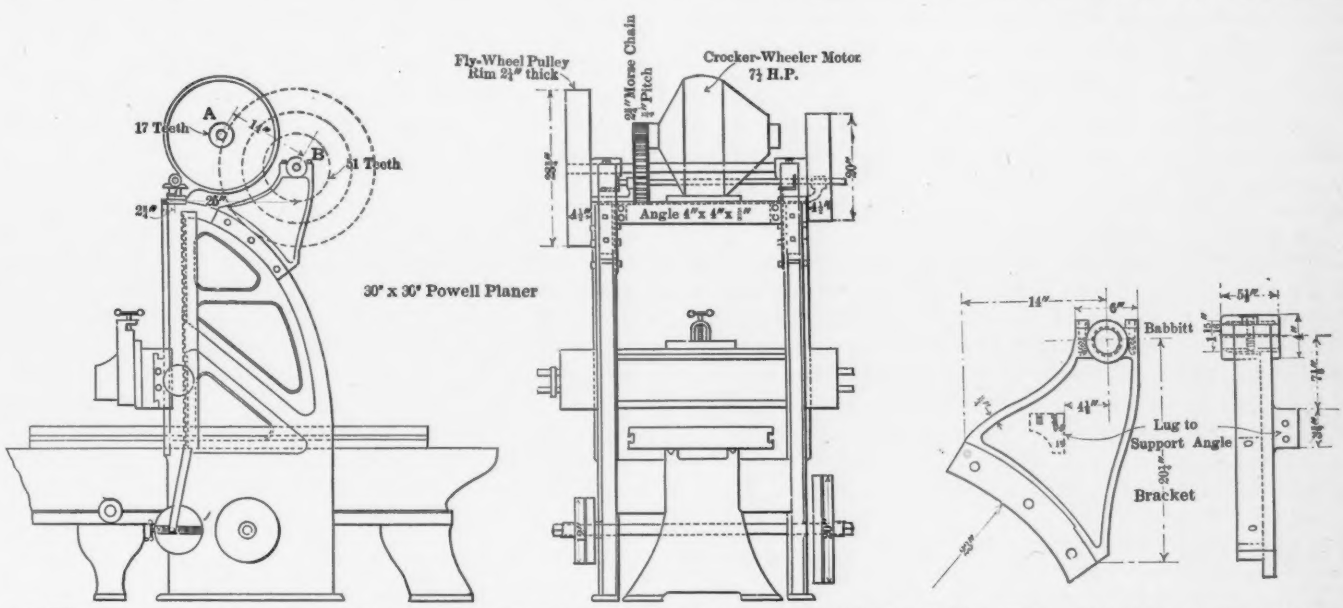


FIG. 55.—DETAILS OF THE MOTOR ARRANGEMENT AND OF THE COUNTERSHAFT SUPPORTING BRACKETS, USED UPON THE POWELL PLANER.

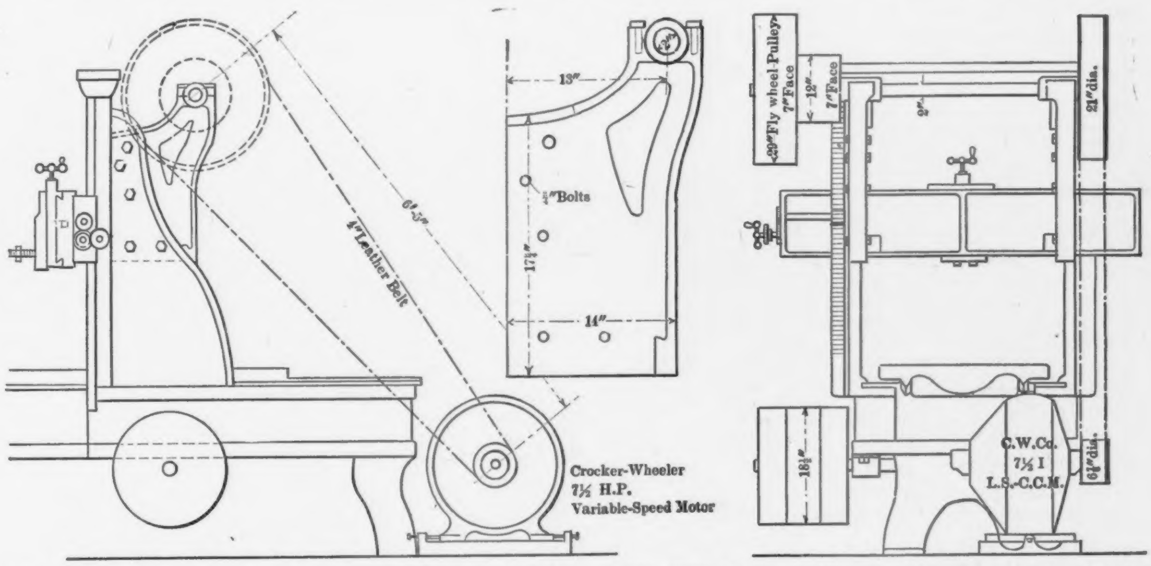


FIG. 56.—DETAILS OF THE BELTED MOTOR-DRIVE THAT WAS APPLIED TO THE NEW HAVEN PLANER, SHOWING STYLE OF COUNTERSHAFT SUPPORTING BRACKET USED.

Another interesting drive which is in service at the McKees Rocks Shops is that used on an old 42-in. x 42-in. x 15-ft. planer (Fig. 53), built by the Cincinnati Planer Company, Cincinnati, Ohio. This tool is fitted with a gear-box furnished by that company, which allows cutting speeds of 15, 20, 25 and 30 ft. per minute, with a constant return speed for the platen of 75 ft. per minute. By making reductions in the motor speed practically any cutting speed between 14 and 30 ft. per minute can be obtained with only slight reductions of the return stroke.

The arrangement of driving, as well as that of the motor,

is practically the same as that illustrated in Fig. 7 of the article upon motor-driven planers appearing upon page 71 of the February, 1904, issue of the AMERICAN ENGINEER AND RAILROAD JOURNAL. A Crocker-Wheeler- 15-H.-P. compound-wound multiple-voltage motor and a type 80-M.F.-18 controller are used in connection with this drive.

Figs. 54 and 55 illustrate an interesting application of a variable-speed motor-drive to an old 30-in. x 30-in. x 8-ft. Powell planer. This planer has a maximum cutting speed of 30 ft. per minute, with a return speed of 72 ft. per minute.

The motor rests partly upon the crossbrace at the top of the housings and partly upon a 4-in. x 4-in. x ⅜-in. angle, bolted in between the cast iron brackets, which are fastened to the housings to carry the countershaft. The countershaft is driven from the motor by means of a Morse silent chain, as is clearly shown. The fly-wheel, which is also used as a belt pulley, is on the countershaft, and is made quite heavy, since the speed of the shaft is comparatively low. A better action could of course be obtained by placing the fly-wheel on an extension of the armature shaft, but in this case such an arrangement could not have been made conveniently.

The planer is driven by a Crocker-Wheeler 7½-H.-P. compound-wound multiple-voltage motor in connection with a type 40-M.F.-18 controller. The controller is bolted to the side of the housing of the planer as shown. It is thus up out of the way, and yet convenient for the operator. The floor stand, or panel board, which is used to carry the switch, fuses and circuit-breaker, is here placed on the floor to the right and close to the tool. On the larger planers it is placed at the rear of the shifting mechanism, and is thus entirely out of the way, although within easy reach if the operator finds it necessary to use the switch or throw in the circuit-breaker.

Another interesting application, one that is remarkable for its inexpensiveness, is that made to an old 30-in. x 30-in. x 8-ft. planer, built by the New Haven Manufacturing Company, New Haven, Conn. The housings of this planer did not appear stiff enough to carry the motor on top, and so two brackets were bolted to the housings to carry the countershaft (see Fig. 56). The motor was set on the floor at the rear of the planer-bed, and is connected to the countershaft by a 4-in. belt, as shown.

The drive on this planer (Fig. 56) was arranged for a cutting speed of 30 ft. per minute, with a return speed of 72 ft. per minute. It is driven by a Crocker-Wheeler 7¼-H.-P. compound-wound motor, which is operated in connection with a type 40-M.F.-18 controller, located upon a floor stand at the right of the planer housing, as shown.

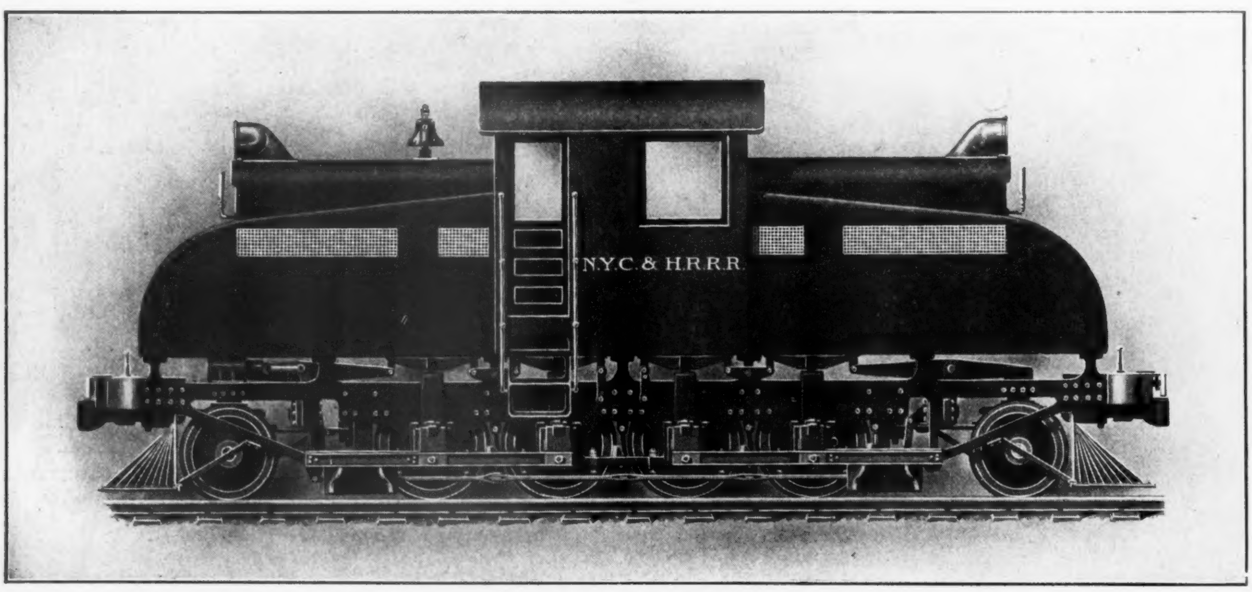
No rule was followed for determining the size of the fly-wheels on these planers. For the first two, which are here described, the Pond and the Cincinnati planers, fly-wheels were applied, as recommended by the tool builders. In the case of the last two, the fly-wheels were made very heavy for the reason that, although the planers were light, the fly-wheels were placed on a countershaft, the speed of which was in each case comparatively low.

NEW ELECTRIC LOCOMOTIVES.

NEW YORK CENTRAL & HUDSON RIVER RAILROAD.

The new electric locomotives which are being built at Schenectady for the New York Central & Hudson River Railroad Company by the General Electric Company and the American Locomotive Company, differ radically in their electrical features from any electric locomotive hitherto constructed. This design was submitted in accordance with specifications prepared by the Electric Traction Commission, appointed by the railroad company, the members of which are Messrs. William J. Wilgus, fifth vice-president, N. Y. C. & H. R. R. R.; John F. Deems, general superintendent of motive power of the railroad company; Bion J. Arnold, Frank J. Sprague and George Gibbs. The secretary of this commission is Mr. Edwin B. Katte, electrical engineer of the railroad company. This commission, after careful deliberation, had prescribed the conditions which must be fulfilled by electric locomotives taking the place of steam locomotives as far as Croton on the Hudson River Line, and as far as North White Plains on the Harlem Division, distances of 34 miles and 24 miles respectively.

These conditions required an electric locomotive capable of making two regular successive trips of one hour each between Grand Central Station and Croton, with a total train weight of 550 tons, a single stop in each direction, and a lay-over not to exceed 20 minutes. In addition to this, it was provided that a similar schedule should be maintained with somewhat lighter trains making more frequent stops. Finally, it was provided that with a total train weight of 435 tons, the electric locomotive should be able to run from Grand Central Station to Croton, without stop, in 44 minutes, and, with one hour lay-over, be able to keep up this service continuously. This last schedule is the equivalent of the present timing of the Empire State Express, though the latter has a somewhat lighter train.



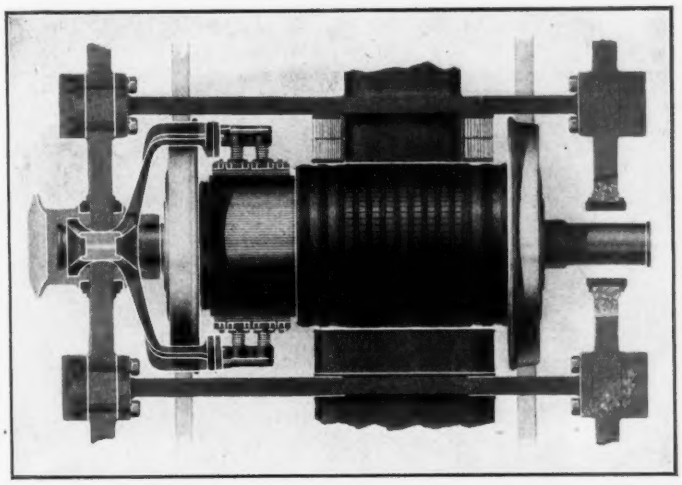
NEW ELECTRIC LOCOMOTIVE, NEW YORK CENTRAL RAILROAD. BY GENERAL ELECTRIC COMPANY AND AMERICAN LOCOMOTIVE COMPANY.

The successful bidders were the General Electric Company, in conjunction with the American Locomotive Company. The choice of a direct-current type of locomotive was dictated largely by its known reliability of service, owing to the amount of experience which had been accumulated with the direct-current motor.

The new electric locomotives will be 37 ft. in length over all. The wheel base will consist of four pairs of motor wheels and two pairs of pony truck wheels, the length of the total wheel

base being 27 ft., and of the rigid wheel base, consisting of four pairs of motor wheels, 13 ft. The diameter of the driving wheels will be 44 ins. and of the truck wheels 36 ins. The driving axles will be 8½ ins. in diameter. It will be what is known as a double-ender, and will weigh approximately 190,000 pounds. The frames will be of cast steel, the side and end frames being bolted together at machined surfaces and stiffened by cast steel cross transoms. The journal boxes and axles will be designed to permit sufficient lateral play to enable the locomotive to pass easily around curves of 230 ft, radius. The superstructure of the locomotive is to be of such form and so designed as to offer the least practicable wind resistance consistent with the adequate housing of the apparatus and its convenient operation. The cab is designed so as to afford a clear view of the track. The whole of the superstructure is to be of sheet steel with angle iron framing, and the doors and windows of the cab are to be fireproof.

Four 600-volt direct-current gearless motors, each of 550-H.-P. will be used. This will make the normal rating of the locomotive 2,200-H.-P., with a maximum rating of about 2,800-H.-P. The armatures will be mounted directly on the axles, and will be centered between the poles by the journal boxes, sliding within finished ways in the side frames. The armature core will be of the iron-clad type, the laminations being assembled on a quill, which will be pressed on the axle. The winding will be of the series drum-barrel type. The conductors



ARRANGEMENT OF ARMATURE, COMMUTATOR AND FRAMES.

will be designed so as to avoid eddy currents, and will be soldered directly into the commutator segments. The commutator will be supported on the quill. The commutator segments will be made of the best hard-drawn copper, with integral ears. The brush-holders will be of cast bronze and mounted on insulated supports attached to the spring saddle over the journal, maintaining a fixed position of the brush-holder in relation to the commutator. Unlike the ordinary four-pole motor, where the magnetic circuit is made througn a separate box casting, the magnetic circuits in this type of electric locomotive are completed through the side and end frames. The pole pieces are cast in the end frames, and there are also double pole pieces between the armatures, carried by bars which act as part of the magnetic circuit. The pole pieces will be shaped so that the armature is free to move between them with ample clearance on the sides. As tne poles move up and down with the riding of the frame on the springs, they will always clear the armature, and provision is made so that the armature will not strike the pole pieces even if the springs are broken. The field coils will be wound on metal spools bolted to the pole pieces, and will consist of flat copper ribbon.

The Sprague-General Electric multiple unit control will be used. Two master controllers in the cab will be so placed that the operating engineer looking ahead will always have one of these under his hand. The control system will permit two or three locomotives to be coupled together in any order in which they happen to come and to be operated as one unit by the engineer in the leading cab. The control system will also be semi-automatic in its action, as it will provide a check on the rate of acceleration of the train, which the engineer cannot exceed, while he may accelerate at any lower rate if he so desires. Should two locomotives break apart the control current will be automatically and instantly cut off from the second locomotive without affecting the ability of the engineer in charge to control the front locomotive under his charge. The control system is designed for a minimum of 300 volts and a maximum of 750 volts.

The weight which will rest upon each of the driving wheels of the electric locomotives will be about 17,000 lbs. Proper distribution and division of the weight among axles will be accomplished by swinging the main frames from a system of elliptical springs and equalizing levers of forged steel, the whole being so arranged as to cross-equalize the load and furnish three points of support.

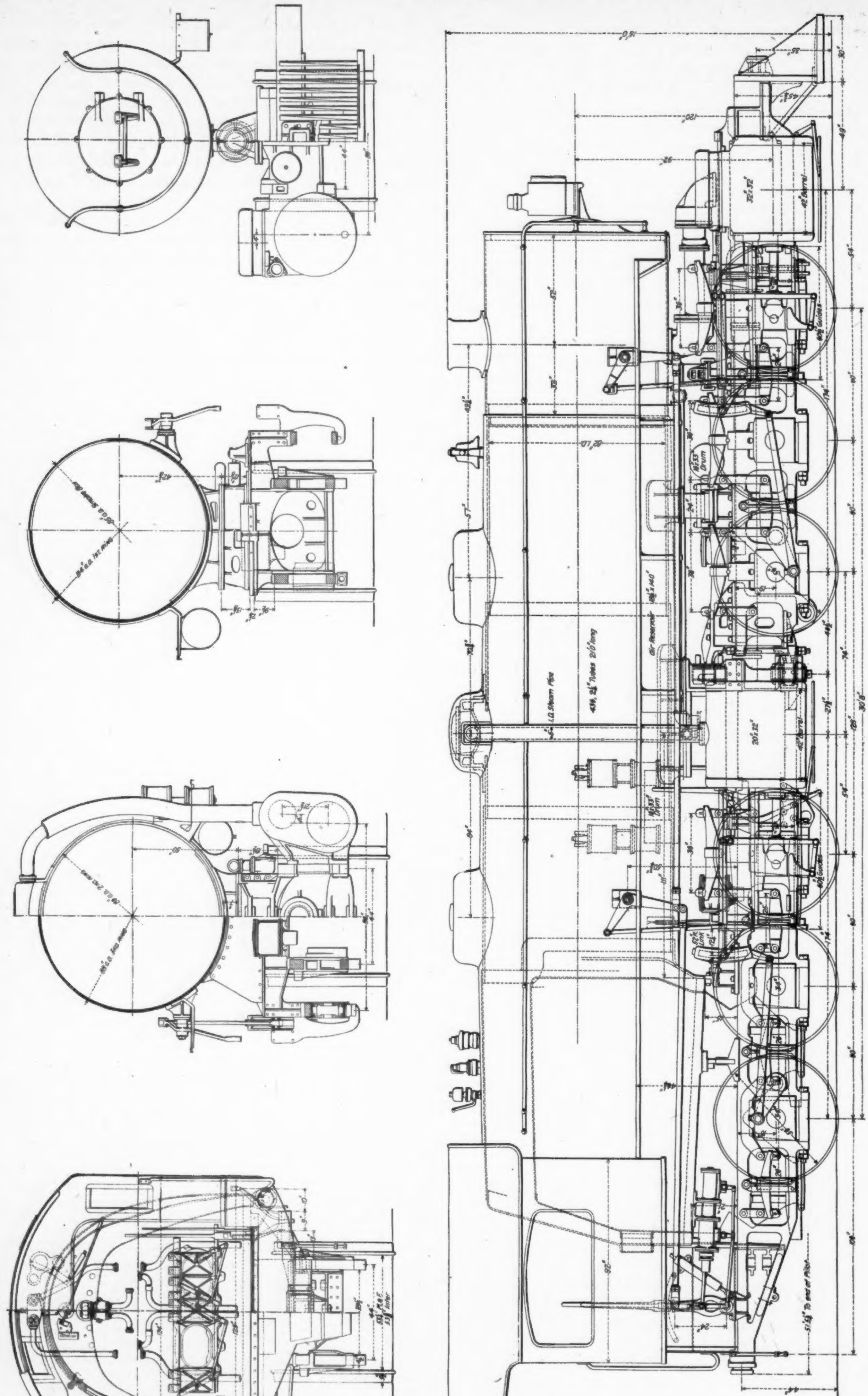
The locomotive will be provided with all the usual accessories of a steam locomotive, including an electric air compressor to furnish air for the brakes; it will have whistles, a bell and an electric pneumatic sanding device and electric headlights at each end. The interior of the cab will also be heated by electric coils.

In actual performance this locomotive is expected to give better results than any engine hitherto placed upon rails. With a light train the locomotive is expected to give speeds up to 75 miles an hour, and with heavier trains similar speeds can be attained by coupling two locomotives together and working them as a single unit. Its tractive force will be greater than that of any passenger locomotive now in existence, and it is believed that in the simplicity and accessibility of its parts and in the provision made in its design to insure continuous operation with the minimum chances of failure, that it marks an entirely new and successful type of electric locomotive.

Mr. S. L. Bean, heretofore master mechanic of the Atchison, Topeka & Santa Fé Railroad, Albuquerque, New Mexico, has been appointed mechanical superintendent of the Coast Lines, with office at Los Angeles, Cal., succeeding Mr. G. R. Joughins, recently resigned.

Mr. David Van Alstyne has been appointed superintendent of motive power of the Northern Pacific Railroad, to succeed Mr. A. E. Mitchell. Mr. Van Alstyne is a graduate of the Massachusetts Institute of Technology. He had his early experience on the Louisville & Nashville, and has, for a number of years, been in the motive power department of the Chicago, Great Western Railway, where, for the last five years, he has held the position of superintendent of motive power. He is thoroughly equipped by training and experience for the important position which he is now taking, and this journal congratulates Mr. Van Alstyne and the Northern Pacific Railroad upon the appointment.

Samuel R. Callaway, president of the American Locomotive Company, died at his home June 1 after a surgical operation. He was born in 1850 in Toronto, Ontario, and began railroad service at the age of 13 years. For six years he was a clerk in the offices of the Grand Trunk; in 1871 he was private secretary to the general manager of the Great Western Railway; in 1874 he was appointed superintendent of the Detroit & Milwaukee Railway; in 1878 general superintendent of the Detroit, Saginaw & Bay City Railway; in 1881 general manager of the Chicago & Grand Trunk and president of the Chicago & Western Indiana; in 1884 he went to the Union Pacific as second vice-president and general manager; in 1887 he was president of the Toledo, St. Louis & Kansas City; in 1895 president of the Nickel Plate; in 1897 president of the Lake Shore & Michigan Southern, and April 27, 1898, he was appointed president of the New York Central & Hudson River R. R., succeeding Chauncey M. Depew. He was active in organizing the American Locomotive Company and had been its president from its inception. He was well known as a railroad officer, strong as a financier, and had hosts of friends.



MALLET ARTICULATED COMPOUND LOCOMOTIVE.—BALTIMORE & OHIO RAILROAD.

J. E. MUHLFELD, *General Superintendent Motive Power.*

AMERICAN LOCOMOTIVE COMPANY, SCHENECTADY WORKS, *Builders.*

(FOR PHOTOGRAPH AND LIST OF DIMENSIONS SEE PAGE 237.)

The Largest and Most Powerful Locomotive in the World.

AN IMPORTANT TEST OF ELLIPTIC SPRINGS.

MADE FOR THE INTERBOROUGH RAPID TRANSIT RAILWAY.

TO DETERMINE PERMANENT SET AND PROPER WORKING FIBER STRESS.

BY S. A. BULLOCK.

The object of this test was to ascertain the greatest possible set this spring would receive under successive applications of light, heavy and excessive loads; and also to determine whether 106,000 pounds per square inch is an efficient fiber stress for the working load of plate springs.

Dimensions of spring before test:

Free height over bands	13¾ ins.
Free height between bands	6½ ins.
Length of spring over all	31½ ins.
Length of spring, center to center	29½ ins.
Plates	3½ x 5-16 ins.

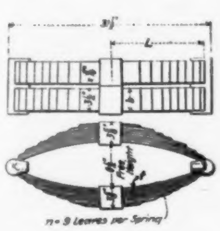


DIAGRAM OF SPRING.

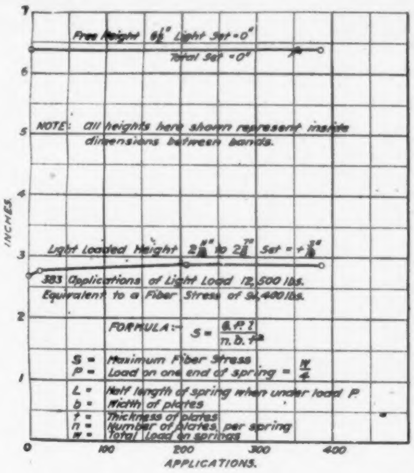


FIG. 1.

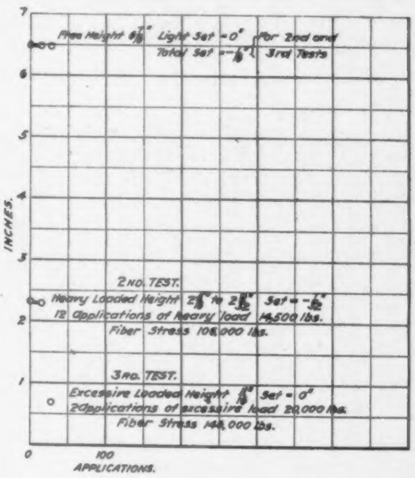


FIG 2.

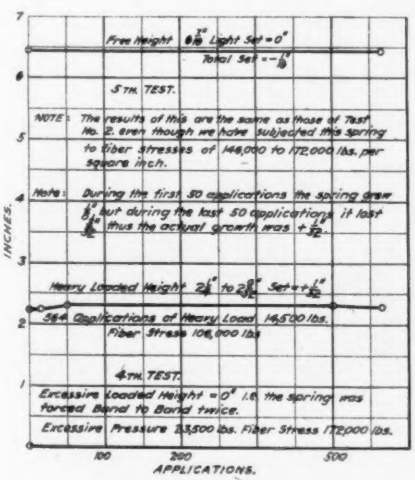


FIG 3.

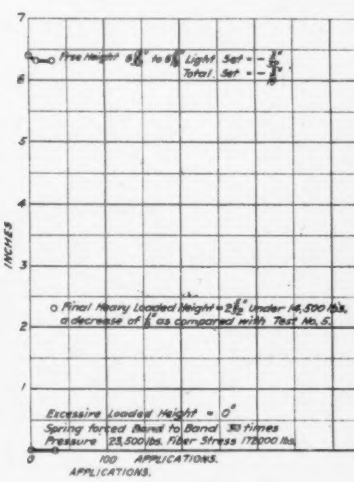


FIG 4.

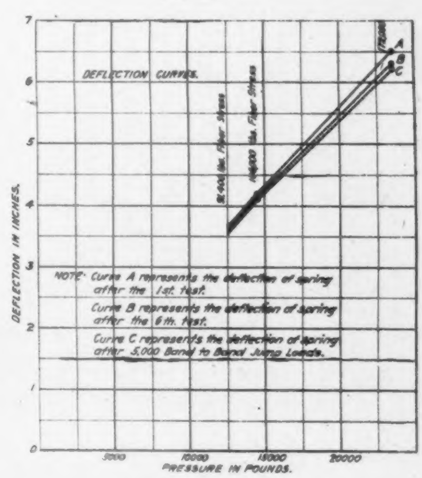


FIG 5.

Number of springs per set	4
Number of plates per spring	9
Style of spring	Double elliptic

During the first six tests the loads were gradually applied and released by a screw testing machine, traveling at the rate of 3 ins. per minute. But in the last test, as shown by curve C (Fig. 5), an hydraulic testing machine was used. The weight-beam was so adjusted that the load could be partially released, and then suddenly forced band to band by moving the lever up and down by hand. For the use of their testing machines we are indebted to the Baldwin Locomotive Works.

This last test was made on a different spring of the same class as the one used in the first six tests, and we have shown it in Fig. 5 for the sake of comparison.

The spring steel was furnished by the Crucible Steel Company of America, and made into springs by the Standard Steel Works, from whom we have the following chemical analysis:

Carbon (combined)	1.01 per cent.
Manganese	.310 per cent.
Phosphorus	.033 per cent.
Sulphur	.025 per cent.
Silicon	.170 per cent.

The first test (Fig. 1), consisted in giving 383 successive applications of the light load of 12,500 pounds, equivalent to a fiber stress of 91,400 pounds. (We have considered L one-half the length of spring under load P, to be equal to 15 ins.)

It is interesting to note that after the first application of the light load, and up to a certain number of applications (207), the spring grew 3-16 in. in the loaded height, the free height remaining constant. After this limiting number of applications, the successive applications of the load produced no further change

The reason for this growth of spring, or increase of efficiency, is due to a decrease of friction between the plates. For in the manufacture of plate-springs there is always scale between the plates and the frequent application and release of this load pulverizes the scale, which then acts as a lubricant, and reduces the friction.

The second test (Fig. 2) consisted of 12 applications of 14,500 pounds, or a fiber stress of 106,000 pounds, producing a set in the free height of minus 1-16 in. and a set of minus 1-32 in. in the loaded height.

The third test (Fig. 2) consisted of two applications of 20,000 pounds (fiber stress 146,000). No additional set was found.

In the fourth test (Fig. 3), the spring was forced band to band twice, requiring an average pressure of about 23,500 pounds, or a fiber stress of 172,000 pounds per square inch. No appreciable set was discovered.

The fifth test (Fig. 3) consisted of 564 applications of the heavy load of 14,500 pounds, producing a fiber stress of 106,000 pounds. During the first 50 applications the spring grew ⅛ in., but lost 3-32 in. during the last 50 applications. Thus the actual growth was 1-32 in., the free height remaining constant.

The sixth test (Fig. 4) consisted of forcing the spring band to band ten times, then applying the test load of 14,500 pounds. This operation was repeated three times.

The first average pressure required to bring the spring

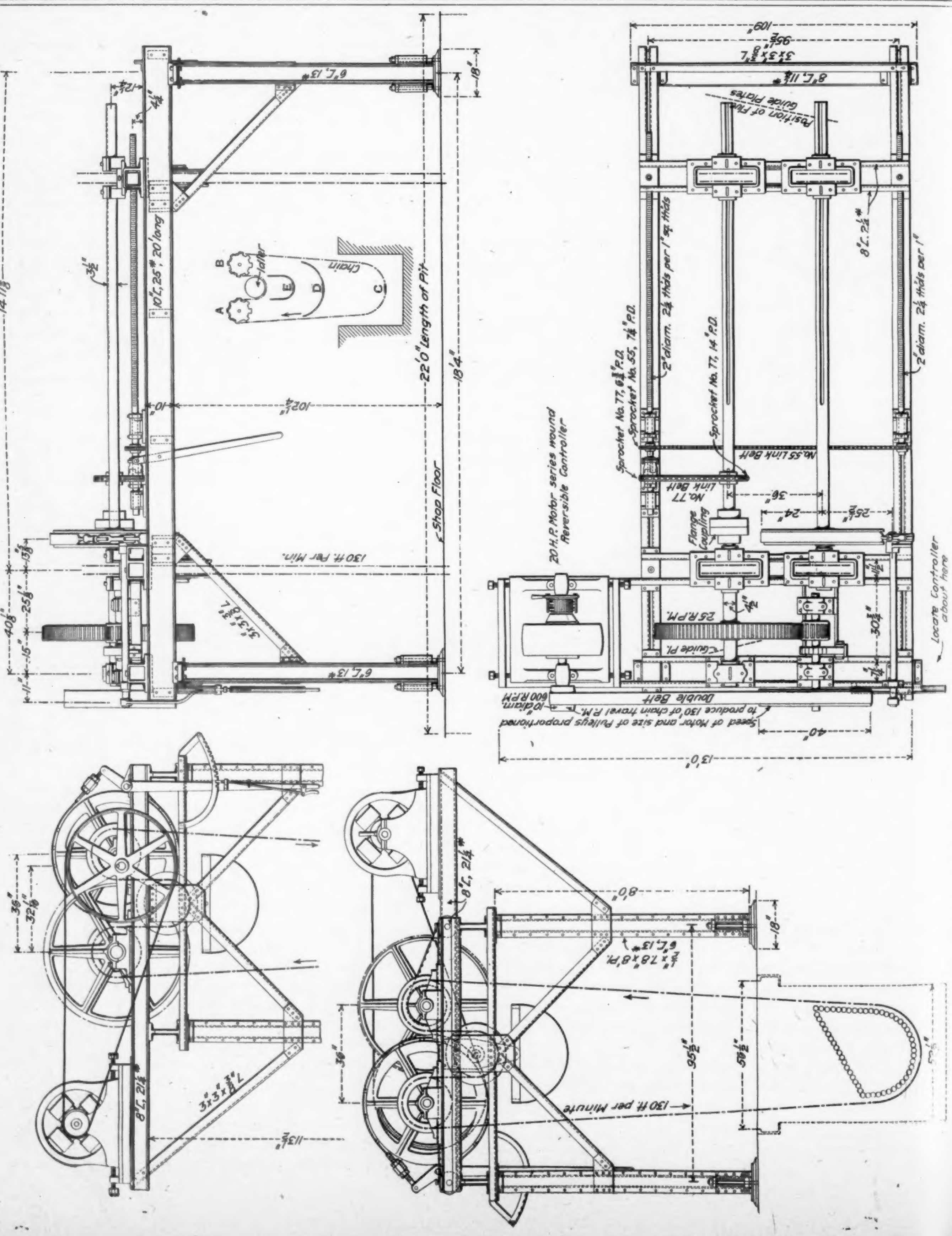
band to band was 23,000 pounds, the successive average pressures required an additional 500 pounds to bring the spring band to band (i. e., 23,500, pounds or fiber stress of 172,000 pounds). The free height additional set was minus 3-32 in. The total light set was minus 3-16 in.

CONCLUSIONS.

Now, from these six tests, we note that 30 band to band applications produced a total set of minus 3-16 in. In the jump test between the 25th and the 5010th application the additional light set was minus 3-32 in. Accordingly, we may infer that the first spring could not receive a total set greater than minus 9-32 in., or that during the life of the spring, curve B (Fig. 5) would never fall below curve C.

Accordingly, it is evident that 106,000 pounds per square inch is allowable for the working fiber stress. The maximum allowable fiber stress can only be determined by more exhaustive experiments upon this subject.

Since all springs are at times subjected to excessive pressures which tend to produce a deformation from which the spring can never recover, we would suggest that when plate springs are tested they shall first be given two applications of that load which would be equivalent to a fiber stress of 146,000 pounds per square inch. Such a pressure to be quickly applied and released, the object being to relieve the spring of most of its set while under the testing machine, and thus insure ourselves against the annoyance of having the spring receive any permanent set when under the car.



NEW MACHINE FOR CLEANING FLUES.—TOPEKA SHOPS, ATCHISON, TOPEKA & SANTA FE RAILWAY.

NEW MACHINE FOR CLEANING FLUES.

ATCHISON, TOPEKA & SANTA FE RAILWAY.

The flues are cleaned in a concrete pit built under the floor this road, was designed to clean a large number of flues at a time, clean them quickly and noiselessly and to reduce to the lowest terms the cost of handling in and out of the machine.

The flues are cleaned in a concrete pit built under the floor of the shop, the size being 4 ft. 8½ in. by 22 ft. by 6 ft. 8 in. deep. It is connected with the sewer and may be filled with water to any desired depth. Flues while being cleaned are suspended in the water by two specially wide-faced, case-hardened wrought-iron chains forming continuous loops, in which the flues roll over and over upon themselves as the chains are driven at a speed of 130 ft. per minute by the gearing overhead, to which a 20-horse-power series wound motor is connected. The motor is furnished with a suitable reversible controller and resistances. To keep the flues in position fenders are provided in the pit and are adjustable to flues from 8 to 20 ft. in length. The rear chain is supported by a traversing carriage which is moved toward or away from the front chain by screws driven by the main driving motor through a clutch. (This is clearly indicated in the drawing.) Thus the rear chain is adjusted to the length of flues. A small diagram shown in the line engraving illustrates the run of each chain and the method of raising and lowering the flues. The sprocket A is keyed to its shaft and drives the chain when the motor is started. The sprocket B is keyed to its shaft, which is independent of the shaft A, and receives its motion from the weight of the chain when it is in motion. If the chain moves in the direction of the arrow and the shaft B is prevented from moving by means of the powerful strap brake, the loop at C will be shortened into the position D. This will raise the flues out of the pit for loading upon a push car which may then be run under them. By this arrangement flues are lowered and raised by the machine itself, and independently of the crane service of the shop.

A lot of flues to be cleaned are brought over the pit on a push car; they are lifted from the car by the chains, the car is removed, the flues lowered into the pit and the machine is started. To place the flues in position to lower requires four minutes and the labor of enough men to push the car. To lower them ready for rolling requires one man one minute. For rattling the flues in this machine about the same time is required as in the barrel forms of rattlers, but this machine saves expense in handling them in and out and it will take from two or three times as many flues as an ordinary rattler. With this machine, the cost to handle flues at the rattler is less than 6 cents per 100 flues. The one in operation at Topeka cleans all of the flues at these shops in the hours from 7 a. m. to 6 p. m., whereas two old-style rattlers were running all day and often at night to keep up with the work, and this was before the capacity of the shops was increased.

To rattle flues when entirely submerged in water requires 28 amperes at 220 volts. When the water level is 14 in. below the top of the pile of flues 34 amperes at the same voltage or 10 electrical horse-power are required. To raise the flues out of the pit requires 68 amperes or 20 electrical horse-power. This machine rattles 200, 2¼-in. flues, 20 ft. long at a time and this requires a 20-h.p. motor.

These drawings and figures were supplied by Mr. Frank H. Adams, superintendent of shop construction of this road, who states that steps have been taken toward securing patent protection. It is understood that the plan was worked out by Mr. Adams and Mr. G. R. Henderson, when Mr. Henderson was superintendent of motive power of this road.

The Society of Engineers of Eastern New York was organized in Albany, April 21, with H. G. Hammett president and Prof. O. S. Landreth vice-president. After a short business session a lecture on aluminum-thermit was presented by Mr. E. Stutz. The idea of this organization was conceived at a meeting of the American Society of Mechanical Engineers at Saratoga, last summer.

NEW LOCOMOTIVE AND CAR SHOPS.

McKEES ROCKS, PA.

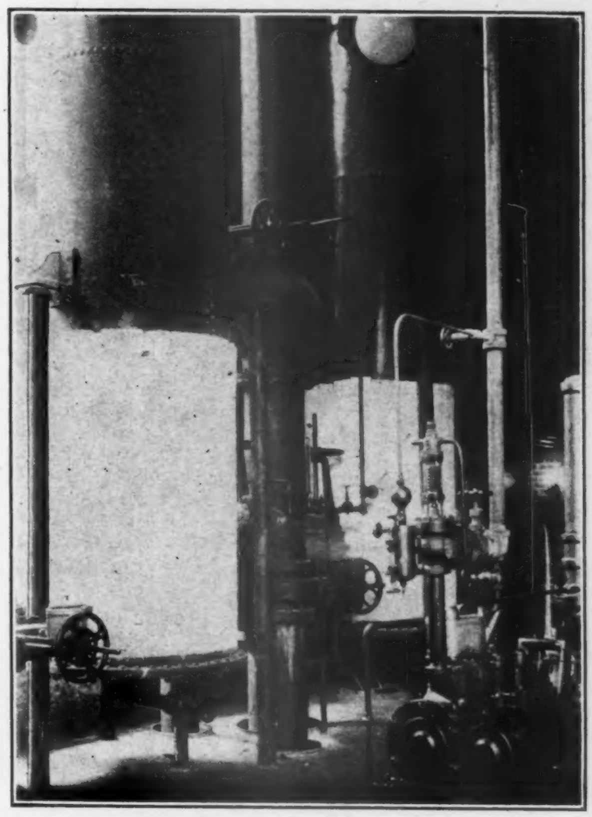
PITTSBURGH AND LAKE ERIE RAILROAD.

VI.

THE HEATING SYSTEM.

An interesting and very important feature of the new repair shops installation at McKees Rocks is the system provided for heating the shop buildings. The particular system used here is worthy of special notice as it involves a departure from the usual methods of shop heating; in it is embodied fixed heating surfaces at the heating points in the buildings, the method of adjusting the shop temperatures being that of varying the temperature of the hot water at the power plant.

A description of this system is of particular interest at the present time on account of the very severe test that it was



VIEW OF THE WATER HEATERS AND PIPING CONNECTIONS IN THE BOILER ROOM OF THE POWER PLANT.

given during the past extremely cold winter. Inasmuch as the system was designed without the precedent of similar practice in heating buildings of the types used at these shops, there was necessarily some apprehension felt as to the successful working of all its many interesting features, but its entirely successful operation throughout has not only removed all doubt, but it has also served to give this system of heating a new and prominent place in questions of railroad shop design. The record of actual results in heating the buildings, which is presented herewith, is of special interest to those concerned with shop problems.

This system of heating embodies the essential features of the ordinary hot water system of heating, in which cast iron or pipe radiators are used in the rooms to be heated, to provide direct radiation. In this system, however, the circulation of the hot water is forced mechanically and made positive, and also the very novel method of adjusting the building temperatures by varying the temperature of the circulating water is resorted to. This permits of maintaining the amount of radiator heating surface constant at all times and places the entire control of the shop temperatures in the hands of an ac-

tendant in the power plant. The system has proven itself the most flexible and most complete arrangement for heating shop buildings that has ever been devised—it is successful because it places the responsibility and control systematically in the hands of one man, whose sole duty it is to look after and operate it.

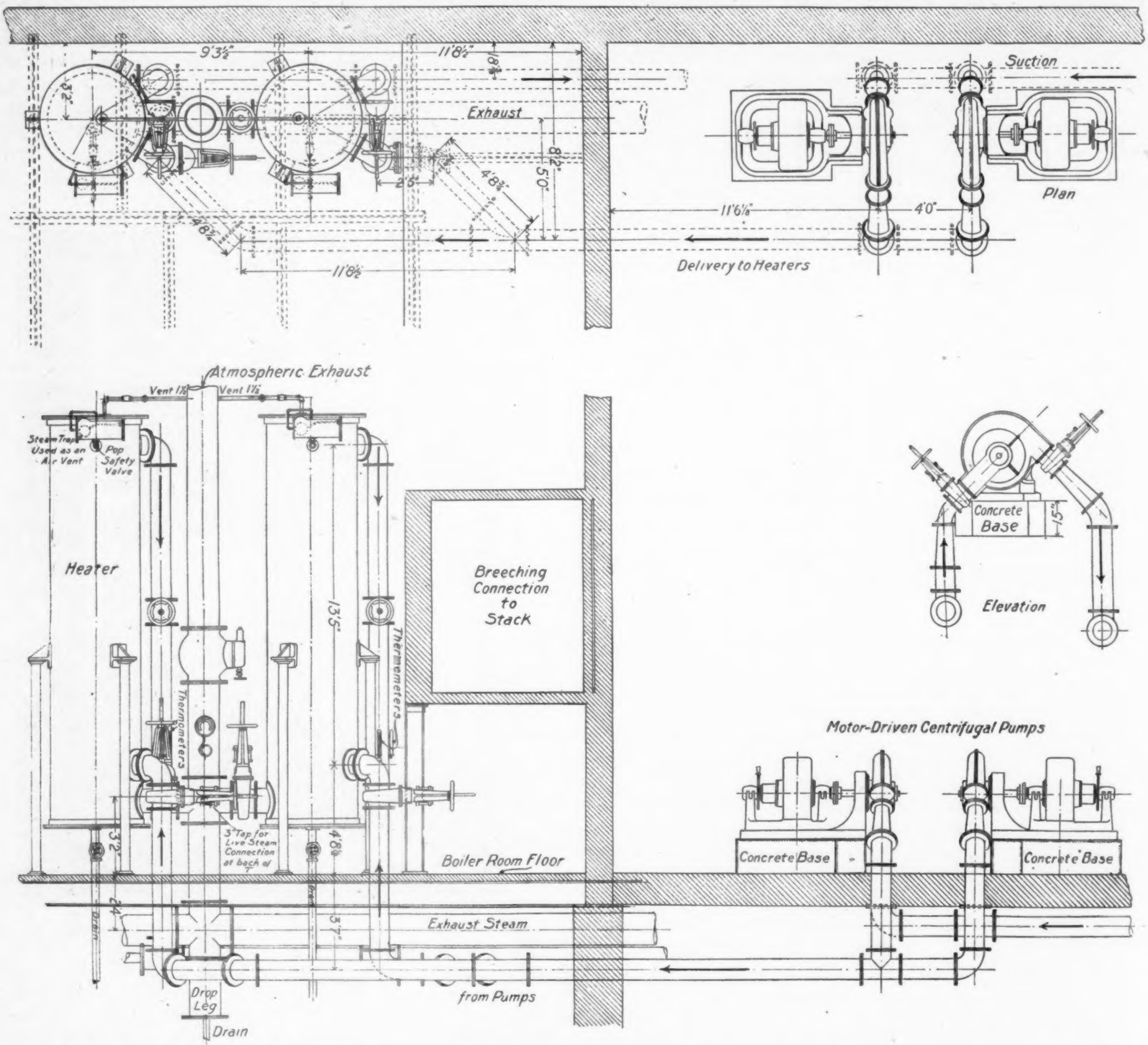
APPARATUS IN POWER PLANT.

The heating and varying of the temperature of the circulating water for the system is accomplished at the power plant, a very complete equipment having been installed for the purpose. There are two centrifugal circulating pumps, which are located in the engine room, as indicated in the accompanying engravings. These are 7-in. Morris centrifugal pumps of 1,500 gallons per minute capacity, and are each driven by a direct connected 35-h.p. Crocker-Wheeler motor. They are connected in multiple so that either or both may be coupled into the system, and entirely without interference with each other. They take their suction from the return side of the system, which leads the water back from the shop radiators, and force it through the hot water heaters and then out into the radiator system again. These connections for the pumps are clearly shown both in the pump detail drawing and in the heater piping drawing for the power plant.

The circulation water is heated and reheated in either one or both of two large vertical condensing water heaters of the closed-tube type, which in construction very closely resembles the closed-tube type of feed-water heater. Each heater contains 235 tubes, 16 ft. long, which give a total heating surface of 1,850 sq. ft. In these heaters the usual procedure is, however, reversed. The water to be heated surrounds the outside of the tubes and the steam is admitted inside of them. Trouble from scaling of the tube surfaces is not met, however, as the water used is not only chemically treated for removal of impurities, but is also used over and over again. Each heater is supported upon pipe struts, as shown in the photograph and drawing, thus making all parts and connections very accessible.

Steam is ordinarily supplied to these heaters from the exhaust mains, from which it enters and gives up its latent heat by condensing upon the cooler tube surfaces. The connections to the exhaust system from the engines, compressors, pumps, etc., are made at a cross in the atmospheric exhaust riser, just below the back pressure relief valve, as shown in the elevation drawing of the heaters. Under ordinary operating conditions and weather, sufficient heating will be available from a natural continuous condensation of the exhaust steam in the heaters, but a live steam connection, operated by a special automatic thermostat, is also provided to supplement the exhaust, if found necessary, or in emergency live steam may be used exclusively for this purpose. A 1½-in. pipe vent connection leads from the top of the steam space to the atmosphere and prevents the same from becoming "air-bound" and inoperative.

The circulation water enters the bottom of the water space in each heater and flows upward, the delivery to the heating



CROSS SECTION AND PART PLAN OF THE POWER HOUSE, SHOWING ARRANGEMENT OF CIRCULATING PUMPS, HEATERS AND PIPING FOR THE HEATING SYSTEM.

M'KEES ROCKS SHOPS.—PITTSBURGH & LAKE ERIE RAILROAD.

system being taken from near the top. These connections, as well as the directions of flow, are clearly shown in the drawing of the power plant and of the heating system piping. It is also obvious that either one or both of the heaters may be connected or cut out of service by means of the valves and connections which are liberally supplied. In this way the service may be made most reliable. At times of ordinary operating conditions one of the heaters may be held as a reserve unit for repairs, etc., but in case of severe weather conditions it is perfectly feasible to operate both in parallel, electric lamps which is in such common use. The flow divides itself proportionately between each radiator unit and the heating effect is thus distributed proportionately to the flow.

The pipes, both delivery and return, leading out from the power plant, are 10-in. wrought iron pipes with flanged connections. They are carried to the various buildings through the piping and wiring tunnel, which was referred to in one of the previous articles of this series, descriptive of the erecting shop. The sizes of pipe used for the branches leading to the paint shop, boiler shop and other buildings vary, of course,

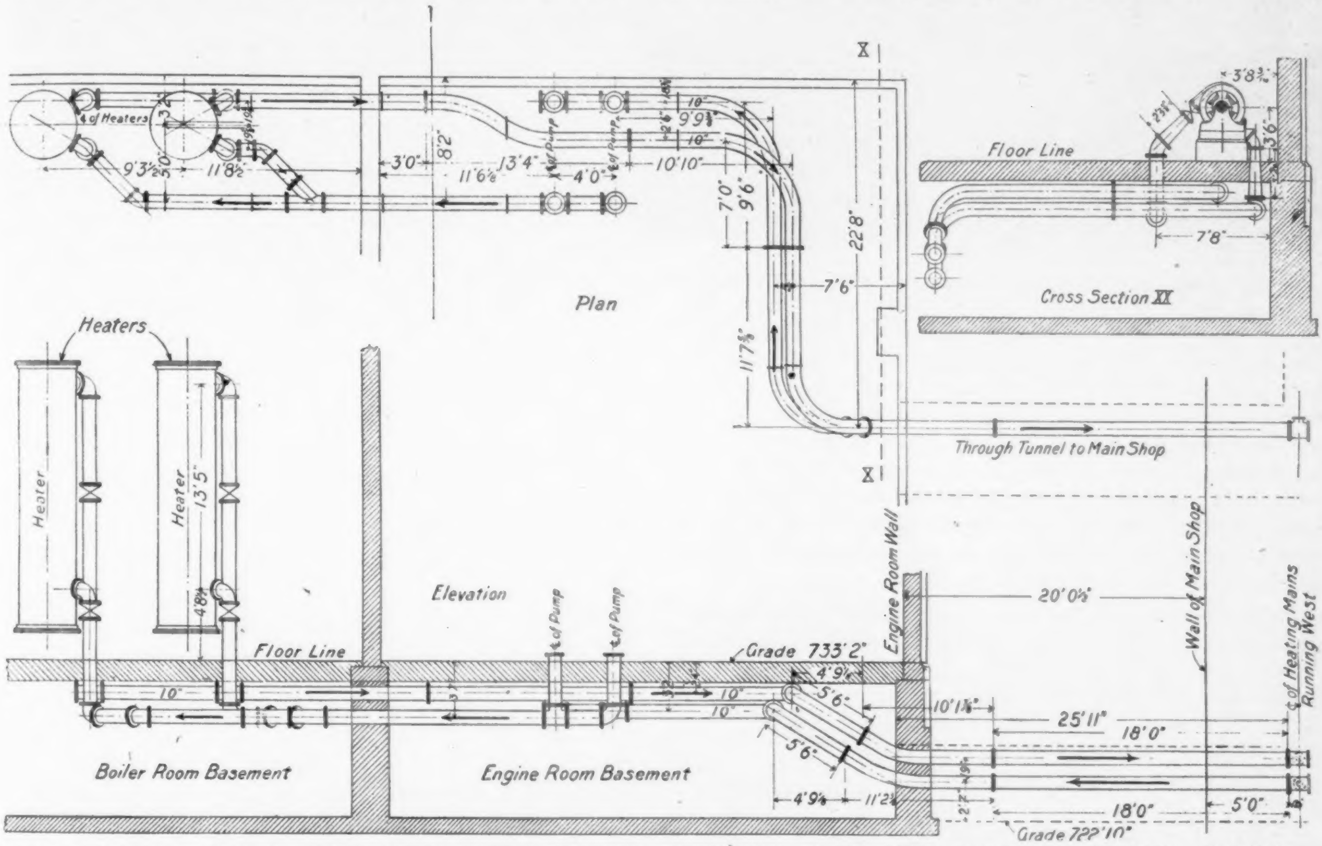


DIAGRAM OF PIPING ARRANGEMENT OF HEATING SYSTEM, SHOWING CONNECTIONS IN THE POWER PLANT, AND DIRECTIONS OF FLOW.

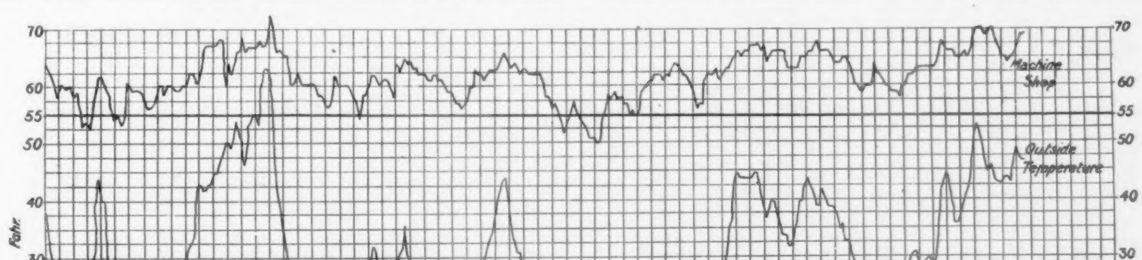


CHART SHOWING HEATING RESULTS PRODUCED DURING MONTH OF FEBRUARY, 1904. UPPER CURVE INDICATES SHOP TEMPERATURES, THE LOWER CURVE OUTSIDE TEMPERATURES.

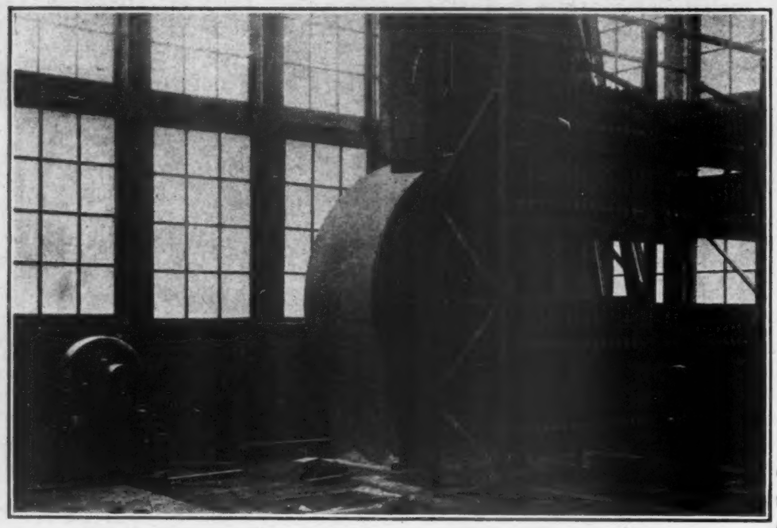
and thus considerable excess of heating capacity is provided in the power plant equipment.

SHOP HEATING APPARATUS.

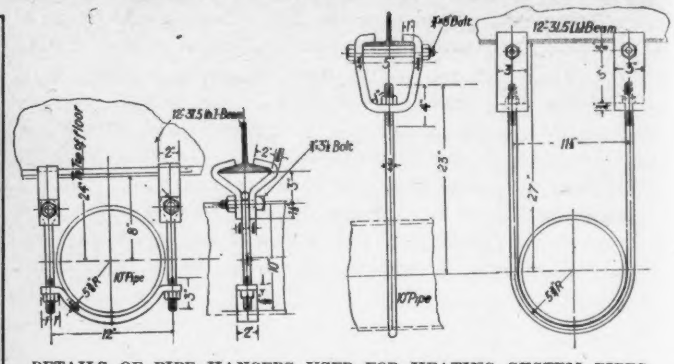
As previously stated, the return circulation from the heating system, extending through the shop buildings to supply the radiators, is drawn back to the power house and forced through the water heaters, to again raise its temperature to that required for heating, and then on out into the heating system again, making a closed circuit through the radiators. Thus the piping system consists merely of two mains, a delivery and a return, between which two every heating radiator is connected; and in this way it resembles in general principle the multiple-arc, or parallel, system of operating incandescent

according to the service. This piping system was installed with great care to provide for expansion; swinging pipe supports of durable and effective designs, as shown in accompanying detail drawings, were used at all points of support. The arrangement of the entire system in the tunnel and in the ducts with removable covers makes the piping most accessible for inspection and repairs, which is thus possible without disturbance of the machinery, and entirely without interference to operations upon the shop floors.

In the shop buildings the heat is transmitted to the air, in all cases, by means of radiators, of either the cast-iron sectional type or of the manifold pipe coil type; in the larger shops, namely the erecting and machine shop, the boiler shop and



VIEW OF THE HEATER AND BLAST FAN IN THE BOILER SHOP (TAKEN DURING PROCESS OF CONSTRUCTION), SHOWING METHOD OF MOUNTING HEATER COILS.



DETAILS OF PIPE HANGERS USED FOR HEATING SYSTEM PIPES.

the paint shop buildings and the roundhouse, the convection method of heating is made use of—that is, blowers are used to distribute the heat in the usual way by forcing air over the hot water radiators, which heated air is delivered around the shops by hot air ducts. In the smaller buildings, however, direct radiation, without the fan blast, is depended upon; these buildings include the storehouse, the color shop, the office buildings, and all office and tool rooms, and the lavatories in the main shop buildings.

For the blower and hot blast systems of heating the radiators are mounted in stacks within a sheet metal casing, through which the air is drawn into the fan; in this way the construction does not differ materially from that used with similar hot-blast systems using steam for the heating medium. A special form of cast-iron radiator is used for this work, which is similar in construction to those used in house heating systems; these have the two important advantages of cheapness in first cost and a maximum durability. The arrangement of the radiator coils, as well as of the construction of the casing-framework, is well shown in the accompanying view, which we were fortunately enabled to obtain of the boiler shop heater while in process of construction. The total number of radiator coils used are arranged in eight groups, of fifteen each, each of which may be cut in or out by a suitable arrangement of valves outside the casting.

The fans distribute the hot air through the shops by ducts, overhead galvanized iron pipes being used in the boiler and paint shops, and masonry ducts beneath the floor in the machine and erecting shop; this latter system of delivering heat was illustrated and described fully on pages 454-457, of the December, 1903, issue, in connection with the description of the main shop building. In the latter installation the heating equipments, of which there are two, are located in separate fan room additions to the building at opposite corners, as shown in the ground plan.

RESULTS.

Interest will naturally center in the results that have been obtained from the actual use of this system in heating the shop buildings during the past severe winter. The diagram on page 222 is a valuable record in this connection, as it illustrates graphically the remarkable performance of the heating system during the month of February of this year, having been prepared especially for this purpose from the regular series of readings of interior and exterior temperatures.

The lower curve of this chart was plotted to indicate the variation of the outdoor temperature continuously from day to day throughout the month; while the upper curve shows the range of temperatures recorded in the main shop building in similar manner continuously. These temperatures were ascertained and recorded hourly by the heating system attendants in the power plant, throughout the 24 hours of each day, and thus present a very close record of events. A careful inspection of the curves will show a remarkably good average temperature for the shops throughout this time, and indicates the possibilities of this method of controlling the building temperatures from a central point with direct reference to the outside temperature. The most notable feature of this diagram is the close resemblance which the upper curve bears to the lower in form; this indicates the dependency of the capacity of this or, in fact, any heating system upon outside weather conditions.

It should be here noted that the system was designed to maintain the temperature of the main shop at 55 degrees F., when the temperature of the outside air is as low as 15 degrees F. This diagram shows how uniformly the system has accomplished this, and even better, as in no case has the shop temperature fallen even as low as the guarantee. This comparison will be facilitated by the heavy horizontal guide lines upon the chart, the upper heavy line referring to the designed shop temperature of 55 degrees F., and the similar heavy line below indicating this chosen average winter temperature of 15 degrees F., upon which the design was based.

Great credit is reflected upon the engineering department of the road for the selection and installation of this interesting and efficient system. It was designed under the direction of Mr. A. R. Raymer, assistant chief engineer, the actual details of designing and construction having been carried out by Westinghouse, Church, Kerr & Co.

INCREASE IN NUMBER AND CAPACITY OF FREIGHT LOCOMOTIVES AND COST OF FUEL AND REPAIRS BY YEARS FROM 1897 TO 1903.

NORFOLK & WESTERN RAILWAY.

Year	No. of Frt. Engines in Use.	P. Ct. Increase.	Total Tractive Power.	P. Ct. Increase.	Average Tractive Power per Engine.	P. Ct. Increase.	Freight Ton Mileage.	P. Ct. Increase.	Freight Ton Mileage per Engine.	P. Ct. Increase.	Freight Ton Mileage per Lb. of Tractive Power.	P. Ct. Increase.	P. Ct. Decrease.	Freight Engine Mileage.	P. Ct. Increase.	P. Ct. Decrease.	Average Mileage per Eng.	P. Ct. Increase.	P. Ct. Decrease.
1897	316	....	6,928,932	....	21,927	....	1,949,450,487	....	6,169,147	....	281.35	....	...	7,753,183	....	....	24,535	....	....
1898	322	1.90	7,171,584	3.51	22,272	1.57	2,301,312,744	18.05	7,146,934	15.86	320.89	14.05	...	8,645,847	11.50	....	26,850	9.46	....
1899	337	4.66	7,959,940	11.00	23,620	6.05	2,456,096,895	6.74	7,288,121	1.97	308.55	....	3.85	8,836,731	2.21	....	26,224	....	2.35
1900	354	5.04	8,693,178	9.20	24,557	3.97	2,732,536,626	11.03	7,719,030	5.90	314.33	1.87	...	9,761,741	10.46	....	27,575	5.15	....
1901	367	3.67	9,508,603	9.37	25,909	5.50	2,864,370,760	4.79	7,804,825	1.11	301.23	....	4.16	8,521,931	....	12.69	23,220	....	15.76
1902	386	5.18	10,181,522	7.08	26,377	1.81	3,151,911,924	10.05	8,165,575	4.63	309.57	2.77	...	10,426,600	22.30	....	27,010	16.60	....
1903	433	12.09	12,411,945	21.90	28,665	8.70	3,639,684,856	15.45	8,405,738	2.94	293.24	....	5.23	12,023,637	15.30	....	27,768	2.48	....
1897 to 1903	...	37.00	....	79.10	.....	30.70	....	86.70	....	35.20	.....	4.23	...	....	55.00	....	.....	13.18	....

INCREASE IN CAPACITY OF LOCOMOTIVES.

Those who have not taken the trouble to compare figures showing the capacity of locomotives during the last few years will find the statement in the accompanying tables startlingly instructive. These tables are presented through the courtesy of Mr. W. H. Lewis, superintendent of motive power of the Norfolk & Western Railway. They indicate the advance which has been made upon that road in seven years. The story told in these figures should be impressed upon every railroad management as indicating the real problem of the motive power department.

The tables are arranged with footings, indicating the per cent. increase and decrease in the various items, and it is noteworthy that whereas the number of freight engines has increased in this period 37 per cent., the total tractive power has increased 79 per cent., and the average tractive power, per engine, has increased 30 per cent. Along with these developments freight ton mileage has increased 86 per cent.; ton mileage per engine, 35 per cent., and freight ton mileage per pound of tractive power, 4 per cent. With 37 per cent. more engines, freight engine mileage has increased 55 per cent., and the average mileage per engine, 13 per cent.

In the matter of fuel there has been an increase of 79 per cent. in the coal used by freight engines, and a decrease of 4 per cent. in the amount of coal used per ton mile. With all the increase in work done the average increased cost of repairs, in terms of 100 freight engine miles, has been but 2 per cent., and the repairs per 1,000-ton miles of freight has actually decreased 15 per cent. During this time the average tons per train has increased 5 per cent., and the average tons per engine 21 per cent.

This statement not only contains a fund of information, which is worthy of study from a commercial standpoint, but it constitutes a most admirable record for the motive power department, considering the fact that during these seven years so little has been added to the facilities for maintenance of these equipments as to amount to practically nothing. The force of these remarks would be appreciated if it were possible to indicate how comparatively little has been added to the shop and roundhouse facilities for the maintenance of the enormously increased equipment of large American railroads.

INCREASE IN NUMBER AND CAPACITY OF FREIGHT LOCOMOTIVES AND COST OF FUEL AND REPAIRS BY YEARS FROM 1897 TO 1903.

NORFOLK & WESTERN RAILWAY.

Year.	Total Coal Used by Freight Engines.	P. Ct. Increase.	Pounds of Coal Used per M. Ton Miles.	P. Ct. Increase.	P. Ct. Decrease.	Average Cost of Repairs per 100 Frt. Engine Miles.	P. Ct. Increase.	P. Ct. Decrease.	Frt. Engine Repairs per M. Ton Miles of Freight.	P. Ct. Increase.	P. Ct. Decrease.	Freight Train Mileage.	P. Ct. Increase.	P. Ct. Decrease.	Average Tons per Train.	P. Ct. Increase.	Average Tons per Engine.	P. Ct. Increase.	P. Ct. Decrease.
1896	....	....	.....	...	...	7.89	....	....	...	....	....	....	....	...	.....	....	.....	....	...
1897	1,192,568,532	....	611.84	...	...	6.41	....	....	.254	....	....	6,055,660	....	...	321.92	....	251.43	....	...
1898	1,366,013,700	14.60	593.58	...	2.98	6.36	....	.78	.239	....	5.91	6,483,290	7.07	...	354.97	10.25	266.17	5.86	...
1899	1,483,307,500	8.57	603.92	1.73	...	6.04	....	5.04	.217	....	9.28	6,392,973	....	1.39	383.87	8.17	277.96	4.42	...
1900	1,540,123,500	3.84	563.63	...	6.66	6.05	.16	....	.216	....	.46	6,281,258	....	1.73	435.03	10.70	279.92	.72	...
1901	1,590,626,900	3.28	555.31	...	1.47	6.82	12.72	....	.203	....	6.01	6,215,897	....	1.05	460.81	5.93	336.11	20.05	...
1902	1,841,112,400	15.80	584.12	5.19	...	5.88	....	13.79	.182	....	10.35	6,625,432	6.60	...	475.73	3.24	322.95	....	3.90
1903	2,132,954,500	15.90	586.02	.33	...	6.54	11.22	....	.216	18.68	....	7.484,929	13.00	...	486.00	2.16	302.71	....	6.25
1897 to 1903	....	79.00	.....	...	4.09	...	2.03	....	...	....	14.96	....	23.60	...	.....	50.90	.....	21.00	...

FAST RUN ON THE MICHIGAN CENTRAL.

Through the courtesy of Mr. E. D. Bronner, superintendent of motive power of the Michigan Central Railroad, details of a fast run made by President Ledyard's special train, from Niagara Falls to Chicago, have been received. This train left Niagara Falls at 5:57 A. M., April 27, and ran over the Michigan Central to Chicago, a distance of 509.71 miles, in 9 hrs. 13 mins., an average speed of 55.31 miles per hour, not deducting stops or the delay of 20 mins. in ferrying across the river at Detroit. Deducting for stops and this delay the running speed averaged 60.87 miles per hour, which is one of the fastest runs for this distance which has been recorded. On the division in Canada, of 225.66 miles, the average speed, excluding stops, was 70.7 miles per hour. From Detroit to Jackson, 75.58 miles were made at 56.6 miles per hour, and from Jackson to Niles, 115.91 miles were made at 62.9 miles per hour, excluding stops in both cases. The remaining division, from Niles to Chicago, 92.62 miles were made at an average speed of 46.7 miles per hour, also excluding stops.

The train was hauled by Atlantic type engines all the way through: Engine No. 483, from Niagara Falls to Windsor, engine No. 263 from Detroit to Jackson, and engine No. 261 from Jackson to Chicago. These engines were all built at the Schenectady works of the American Locomotive Company, the first one in 1901, and the other two in the following year. On this run some remarkable bursts of speed were made, particularly on the Canadian division. As these speeds, however, are all given in even minutes and half minutes, and are taken from the dispatchers' train sheets, they are not sufficiently accurate to justify presentation as indicating the actual speeds. Two of these items record spurts of over 100 miles an hour.

Mr. H. D. Taylor, who recently resigned as superintendent of motive power of the Lehigh Valley Railroad, has been appointed superintendent of motive power of the Philadelphia & Reading Railway, with headquarters at Reading, Pa., to succeed Mr. S. F. Prince Jr., resigned.

Mr. H. B. Hunt and Mr. T. Rumney have been appointed assistant mechanical superintendents of the Erie Railroad, with headquarters at Meadville, Pa. Mr. Rumney is succeeded as master mechanic at Jersey City, N. J., by Mr. William Schlofge.

Mr. J. J. Thomas, Jr., has been appointed master mechanic of the Atlantic Coast Line, with headquarters at South Rockey Mount, N. C., to succeed Mr. J. W. Oplinger, promoted.

Mr. W. A. Nettleton, who for a number of years was superintendent of motive power of the Kansas City, Fort Scott & Memphis Railroad, and afterward assistant superintendent of motive power of the Atchison, Topeka & Santa Fe, has been appointed general superintendent of motive power of the St. Louis & San Francisco system, with headquarters at St. Louis, Mo. Mr. Nettleton began railroad service as a rodman in the engineering department of the Kansas City, Fort Scott & Memphis, in 1885. About a year later he became connected with the Westinghouse Air Brake Company, and in 1887 returned to the Kansas City, Fort Scott & Memphis as air brake inspector. Later he became engineer of tests of that road, and in 1892 was made superintendent of terminals of the Kansas City, Fort Scott & Memphis Bridge Company at Memphis, Tenn. In August, 1893, he returned to the Kansas City, Fort Scott & Memphis, and in April, 1895, was appointed superintendent of motive power and machinery of that road. This position he held until January 30, 1901. In 1902 he was appointed assistant superintendent of motive power of the Atchison, Topeka & Santa Fe, which position he occupied for a short time. Until his recent appointment as general superintendent of motive power of the Frisco system he has been engaged in private business.

(Established 1832.)

AMERICAN ENGINEER AND RAILROAD JOURNAL

PUBLISHED MONTHLY

BY

R. M. VAN ARSDALE.

J. S. BONSALL, Business Manager.

WILLARD C. TYLER, Manager Eastern Dept.

140 NASSAU STREET, NEW YORK.

G. M. BASFORD, Editor.

C. W. OBERT, Associate Editor.

JUNE, 1904.

Subscription.—*$2.00 a year for the United States and Canada; $2.50 a year to Foreign Countries embraced in the Universal Postal Union.*

Remit by Express Money Order, Draft or Post Office Order.

Subscriptions for this paper will be received and copies kept for sale by the

Post Office News Co., 217 Dearborn St., Chicago, Ill.
Damrell & Upham, 283 Washington St., Boston, Mass.
Philip Roeder, 307 North Fourth St., St. Louis, Mo.
R. S. Davis & Co., 346 Fifth Ave., Pittsburg, Pa.
Century News Co., 6 Third St. S., Minneapolis, Minn.
Sampson Low, Marston & Co., Limited, St. Dunstan's House, Fetter Lane, E. C., London, England.

EDITORIAL ANNOUNCEMENTS.

Advertisements. *Nothing will be inserted in this journal for pay,* EXCEPT IN THE ADVERTISING PAGES. *The reading pages will contain only such matter as we consider of interest to our readers.*

Contributions.—*Articles relating to railway rolling stock construction and management and kindred topics, by those who are practically acquainted with these subjects, are specially desired. Also early notices of official changes, and additions of new equipment for the road or the shop, by purchase or construction.*

To Subscribers.—*The* AMERICAN ENGINEER AND RAILROAD JOURNAL *is mailed regularly to every subscriber each month. Any subscriber who fails to receive his paper ought at once to notify the postmaster at the office of delivery, and in case the paper is not then obtained this office should be notified, so that the missing paper may be supplied.* **When a subscriber changes his address** *he ought to notify this office at once, so that the paper may be sent to the proper destination.*

Mr. C. W. Obert, who joined the staff of this journal as associate editor May 1, 1902, retires with the appearance of this number to become associate editor of the *Street Railway Journal*, of New York. His work, especially in connection with machine tools, powerhouses, shops and electrical equipment, has been greatly appreciated, and we wish him the best of success in his new undertaking. Mr. R. V. Wright, mechanical engineer of the Pittsburgh & Lake Erie Railway, joins our staff as associate editor. Mr. Wright comes to us after a thorough technical training and with a number of years of practical railroad experience in connection with locomotives, cars, machine tools and other shop equipment. He has been intimately associated with the design, construction and equipment of the new shops of the Pittsburgh & Lake Erie Railroad at McKees Rocks, Pa., and our readers are already familiar with a portion of his work on the machine tools of that plant through his articles in this journal. We know of no one as well qualified as Mr. Wright to fill this position.

No one can read the letters published in this issue from operating officers and presidents on the subject of big locomotives without clearly seeing how well modern locomotives have met the requirements of heavy traffic in spite of tendencies to overload them and in the absence of adequate facilities for maintaining them. Of course, it is not to be expected that anyone will admit that he has been overloading his locomotives, but it is interesting to see that the general opinion of these gentlemen favors loading lightly enough to maintain average speeds of fifteen or more miles per hour, instead of loading them so heavily that they can scarcely crawl. These letters throw an occasional side light upon the immediate necessity for bringing other road factors up to the big locomotives. The general inadequacy of side track facilities is admitted. Mr. Delano, in reference to lap sidings controlled by interlocking, touched on the question of the vital importance of keeping engines moving when on the road. What the Burlington has accomplished in this direction is worth studying. It is significant that Mr. Kendrick, of the Santa Fe, who has the biggest locomotive in the world, is most outspoken in praise of big engines. The closing remarks of his letter, concerning facilities for dealing with these engines, should be considered by every railroad management in the country. The letters generally indicate that if, instead of merely made bigger, locomotives were really improved in design as they increase in size, there would be fewer failures in spite of the greatly increased duty.

NEW SPECIFICATIONS FOR CAR WHEELS.

An exceedingly important contribution to the subject of car wheels is printed on another page of this issue, in the new proposed specifications presented by Dr. Dudley before the International Association for Testing Materials. These specifications are believed to embody the best information at present known on the subject. Chemical and drop test requirements are included, but the interest in the new specification centers in the part played in the manufacture of wheels by the heat treatment as finally indicated by the tape sizes of the wheels. The tape size permeates the whole specifications. These specifications provide that wheels shall be inspected in groups of three tape sizes and, as explained by Dr. Dudley in his comments upon the specifications, this is a much fairer method of examination than that whereby large numbers of wheels may be rejected unfairly by the old method. In these specifications each tape number will have either a drop or a thermal test. The thermal test is the most important test in this specification and that which tells the most about the wheels as it is designed to simulate conditions of long continued application of the brakes.

These specifications should receive immediate attention by the Master Car Builders' Association, and the fact that they did not originate with that organization should not prevent an immediate study of the subject in the hope of adopting requirements which will not only tend to improve cast iron wheels, but also be fairer than the present requirements to those who are developing the manufacturing side.

A BUSY DAY IN AMERICAN LOCOMOTIVES.

Within an interval of only a few days a group of locomotives has gone on to the rails in this country which constitutes what seems likely to be the most radical and promising improvement which has ever been brought out in the history of the American locomotive. Almost simultaneously the Pennsylvania road puts into service a De Glehn compound, the New York Central the new Cole balanced compound; the Chicago, Burlington & Quincy a Vauclain balanced compound, and the Baltimore & Ohio brings out its enormous freight locomotive of the Mallet type. Appearing at practically the same moment, this is strong medicine, but the patient seems to need it, and those who have watched the development of these types to this point are confident that the result will be a radical improvemen in locomotive practice. It is believed that the appearance of these four engines at the St. Louis World's Fair will in the future be looked upon as an epoch-making event.

The De Glehn compound stands as the most successful type of locomotive in the world, and has been accepted as such by the leading railways of France; this is shown by the fact that the locomotive men of that country have waived their own practice in its favor. The Cole balanced compound stands for an adaptation of many of the successful ideas of the De Glehn system, and the result, so far as it can be shown in trial runs, has surprised those who have been looking for a successful and powerful machine. The Vauclain balanced compound

is the latest development of the builders of more compound locomotives than have been turned out by any other concern, and it has already been cordially accepted by other prominent roads. The Baltimore & Ohio, in its new Mallet pushing engine, while working in a somewhat different line, has taken an audacious step which seems likely to have equally important results in influencing freight locomotive design.

To properly assimilate this remarkable collection of designs, new to our practice, will require the utmost thought and ability of American railroad men. If these designs had come singly they would have been sufficient to indicate a desire to see the locomotive problem attacked scientifically, but to have these four come at once from different directions is very overwhelming proof that those have not been far wrong who have urged the importance of attacking the locomotive problem with a view of placing its development on a plane equal with those of recent years of stationary and marine practice.

These efforts all point in one general direction: that of permitting the use of weight at its best advantage and departing from the principle of developing along the line of increased size and weight alone.

It is unnecessary and in fact impossible to draw comparisons between the three systems for passenger locomotives, or to critically dissect that of the Mallet compound. This will be done through the St. Louis testing plant and road service. Whether or not one shows superior advantages over another is not the important point. Through the influence of these locomotives, practice is sure to take a new turn in the direction of more scientific design, and in addition to this a lesson will be learned which is more immediately important than even that of locomotive improvement.

These locomotives are sure to do more for their weight than any others have ever done. They take a long step in the direction of increased complication, and this means that the engines must be cared for; complication which brings no adequate return has no place in mechanical development, but complication which is incidental to such returns as these locomotives are sure to give will compel attention to running repairs and methods of operation, two factors of the locomotive situation which have been neglected in this country too long. Methods which are not adequate for the maintenance of ordinary simple locomotives must give place to those which are adequate, and while we are about it, why not take a little step in advance and build locomotives which will accomplish more than those in present service?

The opinions expressed in this issue by the best railroad operating men in the country indicate their feelings toward the question of overloading and caring for locomotives. Those who go at all under the surface of the locomotive problem today will agree to the following conclusions:

First. The American locomotive is worthy of more intelligent designing. *Second.* It is worthy of the care and maintenance which is necessary to keep it up to a fair approach to its maximum service capacity. *Third.* It is worthy of intelligent methods of operation which will enable it to do its work upon the road to the best advantage from a commercial standpoint. The skill and good judgment involved in these three principles will surely not now be lacking among men who have brought American railroads to their present high state, and when things and methods are outgrown they will surely turn to that which promises relief.

Time to Sit and Think.—"An economy which I think railroads overlook more often than private corporations is that of providing sufficient supervision of work. The majority of railroad men who are advanced to positions of responsibility have not sufficient time to sit down occasionally and take a deliberate survey of the general situation in their departments, and the result is that while they are driving away at matters which are urgent and to which they are absolutely obliged to give first attention, they overlook economies which might be effected if they had sufficient expert help to relieve them of some of the details which they now have to handle in person."—*M. K. Barnum, before the Western Railway Club.*

RAILWAY SHOPS.

BY R. H. SOULE.

XIV.

CONCLUSIONS.

The several subdivisions of the general subject which have been dealt with will be mentioned seriatim, in order that each may be commented on, and additional information (if any) introduced.

The Erecting Shop.—Table I in the original article gave 24 ft. 9 in. as the greatest spread (centre to centre) of tracks in the longitudinal shops there listed, but attention was called to the fact there had been a tendency towards progressive increase in that spread. Since that time several shops of 25 ft. track spread have been mapped out, and it is known that one road has at least considered a spread of 30 ft. (the building being 90 ft. wide) for the three main longitudinal tracks, intermediate dummy tracks being provided simply for use in wheeling and unwheeling engines. This arrangement would bring into permanent use for standing engines the entire length of each of the three main tracks, and would require only about 1,350 (30x45) sq. ft. of floor space per engine, as compared with the minimum of 1,300 sq. ft. given in Table IV for a transverse shop even under the most favorable conditions.

In the case of transverse shops it was stated that a width of 65 ft. between crane runway columns was sufficient, but this statement should be qualified. If in the design and arrangement of the erecting shop suitable and sufficient space has been reserved for engine truck repairs at one end of the building, but still under the main crane runway, so that engine trucks may be dropped into that space by the crane, then a span of 65 ft. between crane runway columns is quite sufficient; but if, as in some recent new shops, the whole floor space is given over to stalls in which engines are to be stood, it then becomes necessary to repair each engine truck on the track where its engine is standing, and under those circumstances a span of 65 ft. will be found too scant, and it should be increased to, say, 70 ft. In the evolution of the modern transverse shop from the old one there has been a tendency to reduce the width below a comfortable working limit, as by so doing the length and depth (and therefore the cost) of the over-head crane or cranes is kept down to a minimum, and similarly the height of the building up to the lower chord of the roof truss. In the case of the old-style transverse shop, with its cheap timber truss roof, always with minimum head room for any span, there was not the same incentive to curtail the span, and therefore those old shops are remembered as comfortably roomy.

The U. P. shops at Omaha, Neb., and the O. S. L. shops at Pocatello, Ida., afford an interesting comparison of erecting shops, the same cross section of building (combined erecting and machine shops) being used at both places, but the Omaha erecting shop is longitudinal, while that at Pocatello is transverse.

New longitudinal erecting shops have been put up by the Pennsylvania Lines to replace old transverse shops at Columbus, O., and Ft. Wayne, Ind.; in the latter the overhead cranes have a capacity of 75 tons each (with two auxiliary 10-ton hoists), a notable advance from the previous 65 ton-limit. Another valuable feature of the Ft. Wayne arrangement is that the wheel lathes and similar tools are located between the erecting and boiler shops under the sweep of the erecting shop cranes; this practice, originally introduced at the Juniata (Altoona) locomotive building shop, is being incorporated into the design of the latest Pennsylvania repair shops, as at Ft. Wayne and Wilmington, Del. Ft. Wayne also differs from Columbus in having longitudinal storage pits under the floor between tracks.

The new transverse erecting shop of the New York Central at West Albany has a span of nearly 70 ft. between crane

runway posts and therefore has ample room for both an engine and its truck on each track, besides which there is an additional space of 20 ft. under a gallery, the building having a span of 90 ft. The crane arrangement is peculiar, as there are two 60-ton cranes instead of the more usual single 120-ton crane. When engines are being wheeled or unwheeled both are in requisition, and at other times each may work separately, giving double service and quicker movement. As far as known this is the first case where this arrangement has been adopted in a completely new transverse shop, although it had previously been resorted to (as at Bloomington, Ill., on the C. & A.) to make possible the introduction of overhead traveling cranes in an old shop where the head room was limited; with this arrangement, when the two cranes are lifting an engine only bottom yokes are required, and vertical space is saved.

The new double transverse shop of the Lehigh Valley at Sayre, Pa., will probably be put in use late this year and will attract a great deal of attention on account of its great size (48 stalls), the provision of covered yards, and the extension of the erecting shop and machine shop crane service into the boiler shop; it will also have a system of pits (in the covered yards) for the storage of engine strippings.

The new Moline, Ill., erecting shop of the C., R. I. & P. is unusual in many respects; it has a span of 95 ft., the unusually wide shop of the N. Y. C. at West Albany being 90 ft. as above mentioned. It has separate systems of pits for respectively stripping, repairing and wheeling engines, the first and last being longitudinal, while the repair pits (38 in number) are neither longitudinal nor transverse, but are of a sort between these two types and on the herring-bone plan. This arrangement constitutes a new type of erecting shop, and the output results will be a valuable guide to future practice.

The new plant of the Locomotive & Machine Co. of Montreal (now belonging to the American Locomotive Co.) has an erecting shop of the longitudinal type, and stands alone in this respect among American locomotive building shops which are engaged in manufacturing for the railways in general, although a similar shop is found at the Juniata (Altoona, Pa.) construction shop of the Pennsylvania.

At Jackson, Mich., on the M. C., is found both a transverse and a longitudinal erecting shop, in the form of a T, which are worked jointly as one shop.

The new Danville, Ill., shop of the C. & E. I. has a transverse erecting shop with both a heavy (80-ton) overhead crane and a transfer table, an unusual arrangement; in this case the overhead crane is used only for wheeling or unwheeling engines, or handling boilers, or any lighter work, the engines being moved in and out of their stalls over the transfer table. The shop has a span of about 74 ft. between crane runway posts, but a considerable portion of this is taken up by a fringe of heavy tools and a longitudinal track, so the actual working space in the width of the shop is reduced accordingly.

The Machine Shop.—It was stated that average conditions did not suggest the necessity of covering more than about one-third of the floor space with traveling crane service, but it is proper to state that some examples of very recent practice greatly exceed that limit; for instance, Sayre, Pa. (L. V.), 77 per cent., and Moline, Ill. (C., R. I. & P.), 54 per cent. On the other hand, in a large new shop which an Eastern line has under consideration this ratio is 40 per cent., while at Danville, Ill. (C. & E. I.), it is about 33 per cent.

Several complete tool lists have been published, and the data thus supplied, together with additional data which is probably forthcoming, will form a basis from which new lists may be compiled in the future.

The new St. Paul, Minn., shop of the Great Northern has no traveling crane service whatever, and as the roof trusses are inclined from the horizontal (lower chord included) the shafting is hung almost entirely from three lines of wooden posts.

The Moline machine shop tool layout at once attracts attention on account of the large proportion of tools which are placed transversely to the longitudinal axis of the shop; this is made possible by the individual drive and the group drive, as in the latter case a single transverse shaft can serve a considerable number of small tools. This arrangement often gives much better access (from the main longitudinal aisles) to individual tools than under the old system (before electric driving was introduced), when all tools had to be ranged in lines parallel to the main shaft.

The Sayre machine shop will be notable on account of its liberal proportions and its superb day lighting, as its entire floor area, together with the two adjacent covered yards, the whole forming a rectangle 240 ft. by 620 ft., is to be covered by a saw-tooth roof; tire shrinking floors and lye vats, with proper drainage features, are introduced at two central points. In very large plants it becomes burdensome to have to handle work of this character outside of shop buildings; at Sayre these lye vats being of ample size and coming under traveling cranes, it is to be expected that driving wheels on their axles can be treated as readily as smaller parts.

The Boiler Shop.—The capacity of a traveling crane for general floor use was assumed to be 35 tons, and that for a riveting tower crane 25 tons; recently, however, the American Locomotive Co. has finished the boiler for the new B. & O. Mallet articulated compound, and it is found to weigh completed with flues 42 tons, and without flues 28½ tons, which suggests a readjustment of crane capacities if such engines are to be reproduced in the future.

In the extended and re-arranged boiler shop of the Juniata (Altoona, Pa.) plant of the Pennsylvania the re-located 17-ft. stake hydraulic riveter is placed in a pit as before, with ram at a convenient height above floor level, but the old hydraulic crane has been replaced by an electric crane; the operator stands alongside of the riveter and with his left hand works the ram valve lever, his right hand being available for working the handles of three adjacent controllers (of the street car type) by which he can control the three movements (two horizontal and one vertical) of the tower crane to a nicety.

Sayre is almost the only transverse shop which has its boiler shop arranged as a prolongation of the erecting and machine shops with joint crane service throughout; this will give the Sayre boiler shop the use of two 120-ton cranes and six 15-ton cranes, and it will be unique, as regards crane facilities, among American railway repair plants.

Moline, a longitudinal shop, with erecting shop bay in the centre and machine and boiler shops on either side, divides its boiler and tank work, placing its riveter in one end of the erecting shop bay so as to get joint crane service between the two, and reserving the wing (which is served by an independent through track) for tank repairs, and work on the lighter attachments of boilers.

The new boiler shop of the C. & E. I., at Danville, Ill., has traveling cranes covering its entire floor surface; the main bay has a two-trolley 20-ton crane which would seem rather light for heavy boilers even now in use; the crane in the side bay, for light work, is of 3 tons capacity; the stalls are reached by the transfer table which is joint to erecting and boiler shops, the two being in separate buildings.

The Smith Shop.—It was stated that on account of the general use of swing cranes in smith shops it was advisable to provide head room (from floor to lower chord of roof truss) of at least 22 ft. and attention was called to the fact that Collinwood was 24 ft.; since then a tendency to increase this height has been noted, probably to secure better results in the way of clearing the shop of smoke, Moline being 25 ft. 6 ins. and Wilmington, Del. (P. R. R.), being made 33 ft. in imitation of Juniata; the new smith shop at Sayre is, however, 20 ft.

A fine example of smith shop roof construction, with horizonal bracing fully developed, is found in the case of the new Topeka, Kan., shop of the A., T. & S. F.; this feature is so often overlooked and neglected that this particular case is worthy of note (see illustration on page 378 of the AMERICAN ENGINEER for October, 1903).

A very complete equipment of 14 oil furnaces of various sizes and for different purposes has been installed at Moline; the building is not fully occupied at present, as it is proportioned to take care of the work of both the locomotive shops and the car shops, the latter not yet having been built, however.

The Wilmington smith shop has very broad and very high windows, and a large proportion of doors; in this case the object was not so much to secure light as to make it possible to keep the shop comfortably cool in hot weather.

(*To be Concluded.*)

SPECIFICATIONS FOR CAR WHEELS.

By C. B. Dudley.

[These specifications were prepared for the American Society for Testing Materials. They contain exceedingly important improvements, which are explained by Dr. Dudley in extracts from his comments which follow the specifications.—Editor.]

The wheels furnished under these specifications must be made from the best materials, and in accordance with the best foundry methods. The following pattern analysis is given for information, as representing the chemistry of a good cast iron wheel. Successful wheels, varying in some of the constituents quite considerably from the figures given, may be made:

Total carbon	3.50 per cent.
Graphitic carbon	2.90 per cent.
Combined carbon	0.60 per cent.
Silicon	0.70 per cent.
Manganese	0.40 per cent.
Phosphorus	0.50 per cent.
Sulphur	0.08 per cent.

1. Wheels will be inspected and tested at the place of manufacture.

2. All wheels must conform in general design and in measurements to drawings, which will be furnished, and any departure from the standard drawing must be by special permission in writing, and manufacturers wishing to deviate from the standard dimensions must submit duplicate drawings showing the proposed changes, which must be approved.

3. The following table gives data as to weight and tests of various kinds of wheels for different kinds of cars and service:

Wheel.	33-in. Diameter Freight and Passenger Cars.			36-in. Diameter.	
Kind of Service.	60,000 Lbs. Capacity and Less.	70,000 Lbs. Capacity.	100,000 Lbs. Capacity.	Passenger Cars.	Locomotive Tenders.
Number	1	2	3	4	5
Weight, maximum	500 lbs.	650 lbs.	720 lbs.	705 lbs.	760 lbs.
Weight, minimum	560 lbs.	610 lbs.	670 lbs.	680 lbs.	720 lbs.
Height of drop (feet).	12	12	12	12	12
Number of blows	10	12	15	12	15

4. Each wheel must have plainly cast on the outside plate the name of the maker and place of manufacture. Each wheel must also have cast on the inside double plate the date of casting and a serial foundry number. The manufacturer must also provide for the guarantee mark, if so required by the contract. No wheel bearing a duplicate number, or a number which has once been passed upon, will be considered. Numbers of wheels once rejected will remain unfilled. No wheel bearing an indistinct number or date, or any evidence of an altered or defaced number, will be considered.

5. All wheels offered for inspection must have been measured with a standard tape measure and must have the shrinkage number stenciled in plain figures on the inside of the wheel. The standard tape measure must correspond in form and construction to the "Wheel Circumference Measure" established by the Master Car Builders' Association in 1900. The nomenclature of that measure need not, however, be followed, it being sufficient if the graduating marks indicating tape sizes are ¼ in. apart. Any convenient method of showing the shrinkage or stencil number may be employed. Experience shows that standard tape measures elongate a little with use, and it is essential to have them frequently compared and rectified. When ready for inspection, the wheels must be arranged in rows according to shrinkage numbers, all wheels of the same date being grouped together. Wheels bearing dates more than thirty days prior to the date of inspection will not be accepted for test, except by permission. For any single inspection and test only wheels having three consecutive shrinkage or stencil numbers will be considered. The manufacturer will, of course, decide what three shrinkage or stencil numbers he will submit in any given lot of 103 wheels offered, and the same three shrinkage or stencil numbers need not be offered each time.

6. The body of the wheels must be smooth and free from slag and blowholes, and the hubs must be solid. Wheels will not be rejected because of drawing around the center core. The tread and throat of the wheels must be smooth, free from deep and irregular wrinkles, slag, sand wash, chill cracks or swollen rims, and be free from any evidence of hollow rims, and the throat and thread must be practically free from sweat.

7. Wheels tested must show soft, clean, gray iron, free from defects, such as holes containing slag or dirt more than ¼ in. in diameter, or clusters of such holes, honeycombing of iron in the hub, white iron in the plates or hub, or clear white iron around the anchors of chaplets at a greater distance than ½ in. in any direction. The depth of the clear white iron must not exceed ⅞ in. at the throat and 1 in. at the middle of the tread, nor must it be less than ⅜ in. at the throat or any part of the tread. The blending of the white iron with the gray iron behind must be without any distinct line of demarcation, and the iron must not have a mottled appearance in any part of the wheel at a greater distance than 1⅝ in. from the tread or throat. The depth of chill will be determined by inspection of the three test wheels described below, all test wheels being broken for this purpose if necessary. If only one of the three test wheels fails in limits of chill, all the lot under test of the same shrinkage or stencil number will be rejected and the test will be regarded as finished so far as this lot of 103 wheels is concerned. The manufacturer may, however, offer the wheels of the other two shrinkage or stencil numbers, provided they are acceptable in other respects as constituents of another 103 wheels for a subsequent test. If two of the three test wheels fail in limits of chill, the wheels in the lot of 103 of the same shrinkage or stencil number as these two wheels will be rejected, and, as before, the test will be regarded as finished so far as this lot of 103 wheels is concerned. The manufacturer may, however, offer the wheels of the third shrinkage or stencil number, provided they are acceptable in other respects, as constituents of another 103 wheels for a subsequent test. If all three test wheels fail in limits of chill, of course the whole hundred will be rejected.

8. The manufacturer must notify when he is ready to ship not less than 100 wheels; must await the arrival of the inspector; must have a car, or cars, ready to be loaded with the wheels, and must furnish facilities and labor to enable the inspector to inspect, test, load and ship the wheels promptly. Wheels offered for inspection must not be covered with any substance which will hide defects.

9. A hundred or more wheels being ready for test, the inspector will make a list of the wheel numbers, at the same time examining each wheel for defects. Any wheels which fail to conform to specifications by reason of defects must be laid aside, and such wheels will not be accepted for shipment. As individual wheels are rejected, others of the proper shrinkage, or stencil number, may be offered to keep the number good.

10. The inspector will re-tape not less than 10 per cent. of the wheels offered for test, and if he finds any showing wrong tape marking, he will take the whole lot and require them to be restenciled, at the same time having the old stencil marks obliterated. He will weigh and make check measurements of at least 10 per cent. of the wheels offered for test, and if any of these wheels fail to conform to the specification, he will weigh and measure the whole lot, refusing to accept for shipment any wheels which fail in these respects.

11. Experience indicates that wheels with higher shrinkage or lower stencil numbers are more apt to fail on thermal test; more apt to fail on drop test, and more apt to exceed the maximum allowable chill than those with higher stencil or lower shrinkage numbers; while, on the other hand, wheels with higher stencil or lower shrinkage numbers are more apt to be deficient in chill. For each 103 wheels apparently acceptable, the inspector will select three wheels for test—one from each of the three shrinkage or stencil numbers offered. One of

these wheels chosen for this purpose by the inspector must be tested by drop test as follows: The wheel must be placed flange downward in an anvil block weighing not less than 1,700 pounds, set on rubble masonry 2 ft. deep and having three supports not more than 5 in. wide for the flange of the wheel to rest on. It must be struck centrally upon the hub by a weight of 140 pounds, falling from a height as shown in the accompanying table. The end of the falling weight must be flat, so as to strike fairly on the hub, and when by wear the bottom of the weight assumes a round or conical form, it must be replaced. The machine for making this test is shown on drawings which will be furnished. Should the wheels stand, without breaking in two or more pieces, the number of blows shown in the above table, the 100 wheels represented by it will be considered satisfactory as to this test. Should it fail, the whole hundred will be rejected.

12. The other two test wheels must be tested as follows: The wheels must be laid flange down in the sand, and a channelway 1½ in. in width at the center of the tread and 4 in. deep must be molded with green sand around the wheel. The clean tread of the wheel must form one side of this channelway, and the clean flange must form as much of the bottom as its width will cover. The channelway must then be filled to the top from one ladle with molten cast iron, which must be poured directly into the channelway without previous cooling or stirring, and this iron must be so hot, when poured that the ring which is formed when the metal is cold shall be solid or free from wrinkles or layers. Iron at this temperature will usually cut a hole at the point of impact with the flange. In order to avoid spitting during the pouring, the tread and inside of the flange during the thermal test should be covered with a coat of shellac; wheels which are wet or which have been exposed to snow or frost may be warmed sufficiently to dry them or remove the frost before testing, but under no circumstances must the thermal test be applied to a wheel that in any part feels warm to the hand. The time when pouring ceases must be noted, and two minutes later an examination of the wheel under test must be made. If the wheel is found broken in pieces, or if any crack in the plates extends through or into the tread, the test wheel will be regarded as having failed. If both wheels stand, the whole hundred will be accepted as to this test. If both fail, the whole hundred will be rejected. If one only of the thermal test wheels fails, all of the lot under test of the same shrinkage or stencil number will be rejected, and the test will be regarded as finished, so far as this lot of wheels is concerned. The manufacturer may, however, offer the wheels of the other two shrinkage or stencil numbers, provided they are acceptable in other respects, as constituents of another 103 wheels for a subsequent test.

13. All wheels which pass inspection and test will be regarded as accepted, and may be either shipped or stored for future shipment, as arranged. It is desired that shipments should be, as far as possible, in lots of 100 wheels. In all cases the inspector must witness the shipment, and he must give, in his report, the numbers of all wheels inspected and the disposition made of them.

14. Individual wheels will be considered to have failed and will not be accepted or further considered, which: 1st, do not conform to standard design and measurement; 2nd, are under or over weight; 3rd, have the physical defects described in Section 6.

15. Each 103 wheels submitted for test will be considered to have failed and will not be accepted or considered further, if: 1st, the test wheels do not conform to Section 7, especially as to limits of white iron in the throat and tread and around chaplets; 2nd, one of the test wheels does not stand the drop test as described in Section 11; 3rd, both of the two test wheels do not stand the thermal test as described in Section 12.

Comments by Dr. Dudley.

A good deal might be said in explanation of Section 5 concerning tape sizes. It will, perhaps, be sufficient to say that no foundry is able to make its total output all of the same circumferential size, and that experience has shown that there is an intimate relation in any good foundry between successful wheels and tape sizes. There are several reasons why the output of a foundry varies in diameter or circumferential measurement. First, although the moulds are supposed to be of the same size, yet, as a matter of fact, this is not the case. Moreover, a mould which has been used a number of times is apt to increase a little in diameter, and also to wear a little. This cause for variation in tape sizes is not a very serious matter, however, as efforts are usually made to keep the moulds fairly uniform in size. Another cause for variation is temperature of pouring. It will be readily understood that greater shrinkage is characteristic of metal cast at high temperatures. Furthermore, difference in chemical composition makes some difference in the shrinkage. However, the most important cause for variation in tape sizes is the effect of the annealing pit. It is well known that as fast as the wheels are taken out of the moulds, while they are still red hot, they are put in annealing pits, containing 15 wheels, or more. The annealing pits are made of metal tubes, lined with fire brick, the interstices between the pits being filled with sand, the object of the whole device being to allow the wheel to cool slowly. It is common practice to allow the wheels to remain in the pits four days. While in the pits certain changes take place in the metal, and it is well known that the usual effect of annealing is to increase the tape size of the wheel a little. Experiments have been made which indicate that a re-annealing—that is, putting a wheel into the pit a second time, between a number of freshly cast hot wheels—will increase the tape size up to sometimes two numbers. Furthermore, the wheels at the top and bottom of the pit do not increase the same as those in the middle of the pit. It is perhaps not necessary at this time to go into the changes which take place in the annealing pit further than to say that those wheels which come out of the pit nearest to the size which they had when put into the pit—or, what amounts to the same thing, those wheels which are less annealed—are found by experience to be most likely to fail on drop test, and also less likely to stand the thermal test. It will be seen, therefore, that there is a very intimate relation between tape sizes and successful output, and this will explain why so much reliance is placed on the tape sizes.

Section 7 has to do with the chill. As already explained, the tape number is an important element in the wheel, and in addition to strength and ability to stand thermal test, the chill, likewise, is a function of the tape number. The lowest tape numbers in any foundry will be apt to have the highest chill, and may fail on test from having too much chill, while the higher tape numbers, which mean the greater circumference, have the least chill, and may fail from having too little chill. The requirements of Section 7 in regard to rejections are based on a good deal of experience. It was formerly the custom to reject a whole 100 wheels if the test wheels failed from any cause. This was believed to be a hardship by the manufacturers, and in view of the intimate relation between tape sizes and successful wheels there has been introduced into these specifications, as is seen, authority only to reject out of each 100 wheels tested, the other wheels of the same tape number as the wheel which failed allowing the other tape numbers to come up again.

Taken as a whole, it is perhaps safe to say that for ordinary service, by which is meant for all service except under 40 and 50-ton freight cars, wheels which will pass the tests of these specifications will be safe and give fairly good results in service. There are some points in connection with the failure of wheels under heavy cars that need further study, and it is more probable that as this study progresses it may be found essential to change or modify some of the requirements of the specifications. The special failure of wheels under heavy cars is a circumferential crack either in the tread or in the throat of the wheel, resulting sometimes in the breaking off of the flanges. The causes leading up to this failure are complicated, and it is probable that modifications in the design of the cars themselves may very greatly diminish the number of failures of this kind.

NEW LOCOMOTIVE AND CAR SHOPS.

COLLINWOOD, OHIO.

LAKE SHORE & MICHIGAN SOUTHERN RAILWAY.

XIV.

THE WOOD MILL.

The preceding articles of this series have described the essential and interesting features of the yard layout plan and of the building construction used in the Collinwood car department repair shops. In this article will be discussed that important department of the car repair work, the wood mill. This wood mill is of particular interest to railroad shop men on account of the many new features and radical departures from existing practice that are involved: it represents an advanced stage of the art of arranging and operating wood-working tools that is unequaled in any other similar shop.

The location of the wood mill building was selected in accordance with the most approved practice in this line, and provides a very convenient arrangement for ease of handling both rough and finished work. As indicated in the layout plan of the car shops (see page 408 of the November, 1903, issue), this shop is located between the lumber storage department, including the dry kilns and dry lumber storage building, at the east end of the shop yard, and the points of lumber consumption, the car repair shops and freight car repair yard, on the other side. This results in a centralization of the work around this important focal point of the department, making it very convenient to prepare and deliver finished lumber to the repair jobs where it is needed.

This building is conveniently served by tracks, which give ready access for delivering rough lumber and also removing dressed and sized stock. As may be seen from the layout plan above referred to, two inside track connections, supplemented by two outside tracks lead to the eastward to the lumber yard, where access is provided by conveniently-arranged longitudinal tracks to the long lumber piles; in this way sills and other car timbers, as well as smaller stock, can be quickly delivered to the dry kilns or wood mill ready for milling. A track connection is also made with the dry lumber shed, in which the lumber is stored after being kiln-dried, until delivery to the wood mill is necessary.

The delivery of dressed lumber from the wood mill to points of consumption for repairs is made easy by its convenient location alongside the freight car repair yard and close to the freight and passenger car repair shop buildings. Track connections are liberally provided by the general transfer table arrangement, while the planking in the freight car repair yard permits of delivery to any part by trucks. The cabinet shop, which occupies the north end of the heavy freight repair shop building, has track connection with both the wood mill and the dry lumber shed for facility in receiving material.

Perhaps the most important feature of the wood mill is the arrangement of its machinery, which was worked out to provide easy combinations for handling the bulky and heavy pieces of stock. The arrangement was so designed that all work will progress naturally from the entering (east) end of the mill westward in the course of the milling operations. This may be studied by reference to the accompanying floor-plan drawing of this shop. All sills and heavy timber work is brought in on stub-track A, and is unloaded alongside the two 4-side timber sizers; after passing these machines the work is laid down naturally in front of the gainers and tenoning machine, which constitute the next following step. After passing the latter machines the work is next laid down, naturally, in front of the multiple-spindle vertical boring machine for the completing operation. This arrangement of handling heavy stock absolutely avoids the necessity of moving timber backward in the courses of its milling, all steps coming in a natural, progressive order through the shop.

Track B leads through the shop from end to end, as shown, it being intended to serve the various machines used in light lumber dressing. The arrangement of these machines is obviously less important than that necessary in the heavy section, but still it may be seen to be such as to bring the roughing machines first, such as the matchers, supplemented by the rip and cut-off saws, at the incoming end of the building, after which are to be found the finishing machines, such as the dado, boring and tenoning machies, band saws, etc., although their exact arrangement is here of less importance. The selections of tools used in this shop may be learned from the following tool list, which also includes those for the cabinet shop:

TOOL LIST.—CAR DEPARTMENT SHOPS.

WOOD MILL.

No.	Tool.	Builder.	Size of Motor.
321	Four-side timber planer	Fay & Egan	35 h.p.
322	Four-side timber planer	Amn. W. W. Mach. Co.	35 h.p.
323	"Lightning" matcher	Fay & Egan	25 h.p.
324	No. 27 matcher	S. A. Woods Machine Co.	35 h.p.
325	No 6 automatic cut-off saw	Greenlee Bros.	20 h.p.
326	No. 4 vertical end tenoner	Greenlee Bros.	15 h.p.
327	No. 4 rip saw	S. A. Woods Machine Co.	20 h.p.
328	No. 4 cut-off saw, automatic	Greenlee Bros.	15 h.p.
329	No. 8 vertical saw and gainer	Fay & Egan	20 h.p.
332	No. 3 automatic cut-off saw	Greenlee Bros.	15 h.p.
333	No. 3 rip saw	Greenlee Bros.	20 h.p.
334	Automatic saw and dado	Greenlee Bros.	15 h.p.
335	40-in. bevel band saw	Williamsport Mach. Co.	10 h.p.
336	42-in. band saw	Fay & Egan	7½ h.p.
337	H. C. horizontal mortiser	Fay & Egan	15 h.p.
338	No. 7 vertical mortiser and borer	Greenlee Bros.	15 h.p.
339	No. 3 gainer	Fay & Egan	15 h.p.
340	No. 70 tenoner	Fay & Egan	7½ h.p.
341	Four-spindle horiz. boring mach.	Greenlee Bros.	10 h.p.
342	Jointer	Fay & Egan	7½ h.p.
344	24-in. pony planer	S. A. Woods Machine Co.	10 h.p.
345	No. 3 gainer with 4-spin. borer	Greenlee Bros.	{ 10 h.p. / 15 h.p.
346	Double-head shaper	Grosvenor	7½ h.p.
430	Automatic saw filer		} 7½ h.p.
431	Automatic knife grinder		} 7½ h.p.
432	Automatic saw grinder		} 7½ h.p.
433	Band-saw filer		} 7½ h.p.
437	Wood lathe	Fay & Egan	} 7½ h.p.

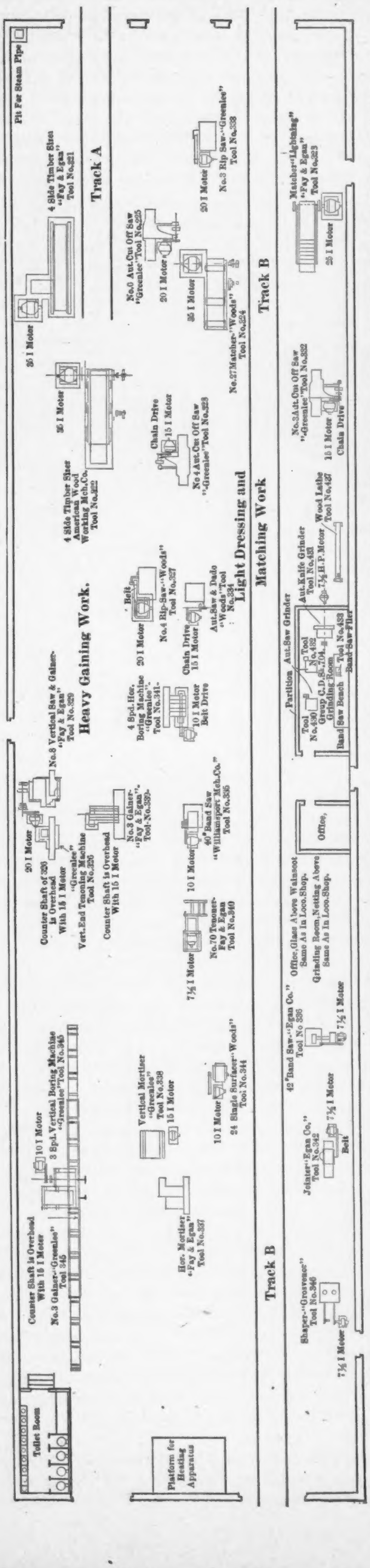
CABINET SHOP.

No.	Tool.	Builder.	
451	Sticker	R. & H.	Group-Driven
452	Jointer	Clement	Group-Driven
453	42-in. band saw	Fay & Egan	Group-Driven
454	3½-in. tenoner	Fay & Egan	Group-Driven
455	No. 3 shaper	Clement	Group-Driven
456	7 x 24-in. surfacer	Whitney	Group-Driven
457	No. 6 scroll saw	Fay & Egan	Group-Driven
458	84-in. sander		Group-Driven
459	Wood-carving machine		Group-Driven
460	Wood lathe		Group-Driven
461	24-in. pattern lathe	Fay & Egan	Group-Driven
462	Universal saw bench	Amn. W. W. Mach Co.	Group-Driven
463	Sash mortiser	Greenlee Bros.	Group-Driven
464	Combination rip and cut-off saw	S. A. Woods Machine Co.	Group-Driven
466	No. 3 self-feed rip saw	Greenlee Bros.	Group-Driven

Some representative views are presented herewith of the machines with which this shop is equipped, which will also serve to indicate the general character of the arrangement of the mill. A noticeable feature of this shop is the absence of belting and countershafting, all the machines being individually driven by motors, with the exception of five tools at the south side of the shop, which are driven in a group; with the latter exception, however, scarcely a belt is to be seen in the entire building, making a very clean and light shop arrangement. The absence of belts and countershafting enables the full effect of the sky-lighting to be gained—an important factor in shop operation, which is highly conducive to the comfort and convenience of the workmen.

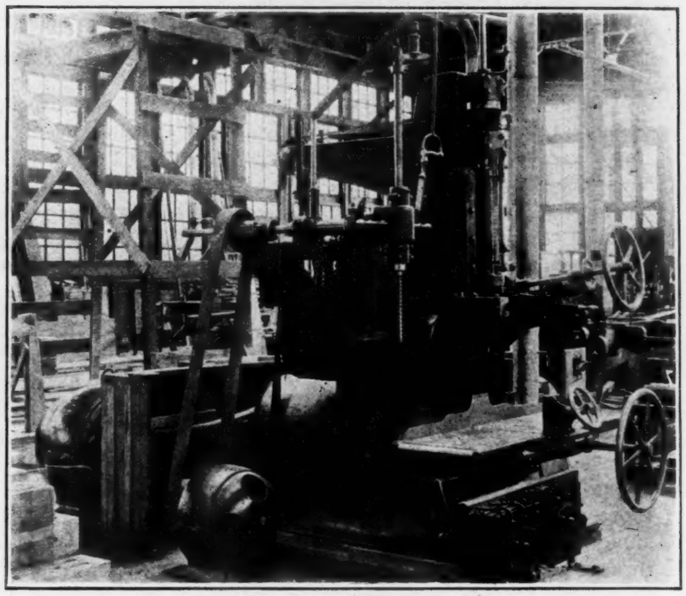
An important tool in this class of work is the hollow-chisel mortiser (tool No. 338), which is shown in the first view. This machine has a wide range of adjustments, providing for any mortising work that may be required for car repairs, and they are all easily and quickly controlled from the front. It has also a very convenient attachment in the form of a special boring spindle, mounted upon its left-hand side for ease of locating holes in work while mortising, thus avoiding the necessity of removal to a boring machine in many cases. This tool was built by Greenlee Bros. & Co., Chicago, Ill. It is driven through a Morse silent chain by a 15-H.P. Crocker-Wheeler constant speed motor, the special boring attachment being separately belt-driven by a similar motor of 5-H.P. capacity. A feature of its driving arrangement is the location of the two starting boxes for the motors, conveniently for the operator near the front of the table, so that the tool is thoroughly under his control.

The following engraving illustrates an interesting design of 4-spindle horizontal boring machine (tool No. 341) for boring car sills, beams and other heavy work. This machine, which

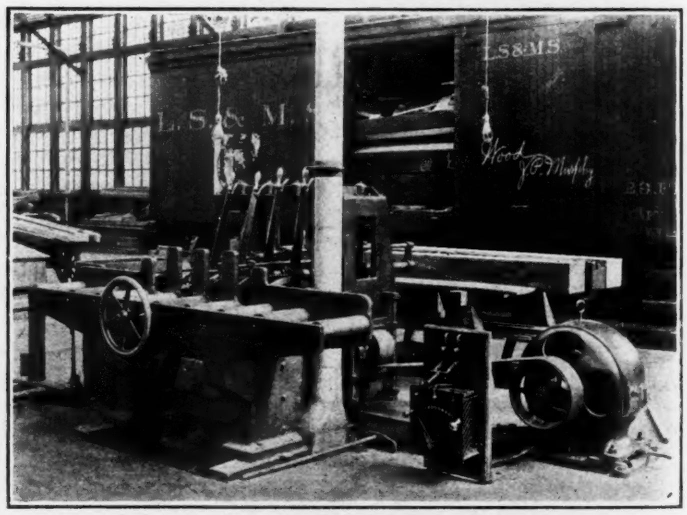


FLOOR PLAN OF THE WOOD MILL, SHOWING TRACK FACILITIES AND ARRANGEMENT OF MACHINERY.—COLLINGWOOD CAR SHOPS.—LAKE SHORE & MICHIGAN SOUTHERN RAILROAD.

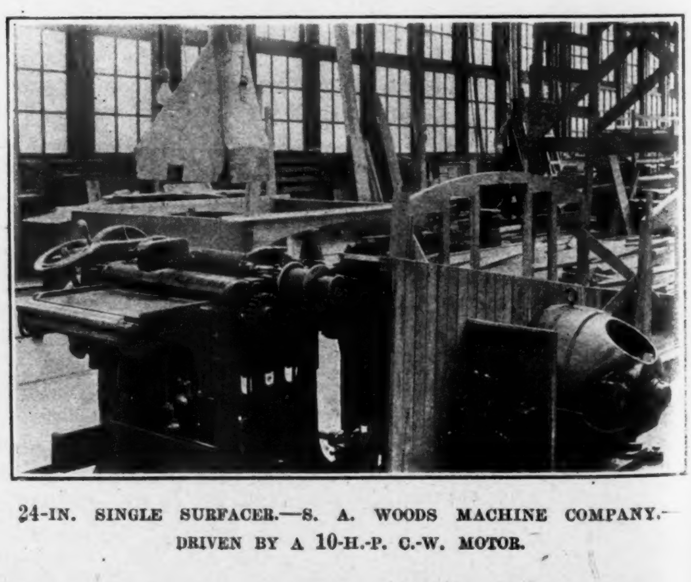
was also built by Greenlee Bros. & Co., Chicago, Ill., is specially arranged for ease of manipulation, and is rapid and accurate; the table is especially arranged for quick adjustments, and is very convenient. It is driven through belt connection by an individual motor (Crocker-Wheeler), mounted upon the floor at the right of the tool, which is of 10-H.-P. capacity, operating at constant speed. This would seem to be



GREENLEE HOLLOW CHISEL MORTISER, WITH BORING ATTACHMENT. —DRIVEN BY CROCKER-WHEELER CONSTANT-SPEED MOTORS.



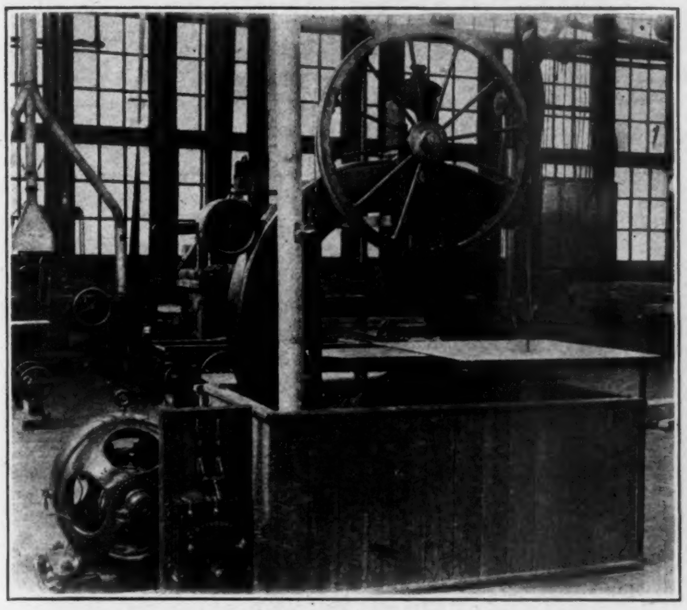
MOTOR-DRIVEN GREENLEE 4-SPINDLE HORIZONTAL BORING MACHINE. —10 H.-P. C.-W. MOTOR.



24-IN. SINGLE SURFACER.—S. A. WOODS MACHINE COMPANY.—DRIVEN BY A 10-H.-P. C.-W. MOTOR.

a rather large motor for a tool of this class, but it was intended to provide ample power for rapid and effective work.

In another view is shown a 24-in. single surfacer (tool No. 344), that was installed for use in handling light stock and

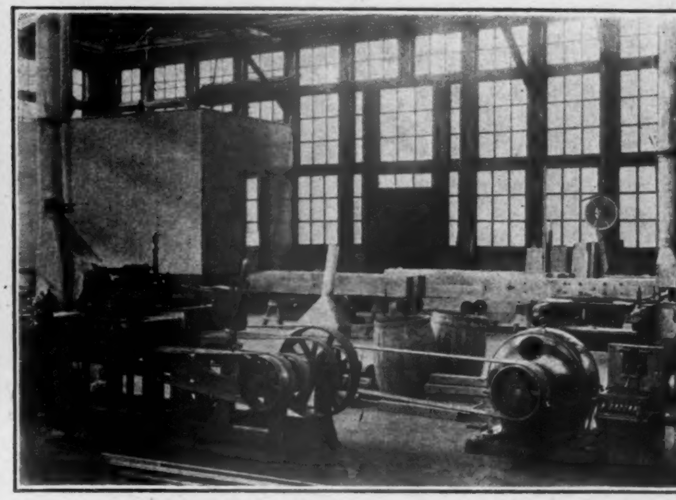


TYPICAL BAND SAW DRIVE.—10-H.P. C.-W. MOTOR BELTED TO DRIVE.

special classes of work. This tool is the well known surfacer built by the S. A. Woods Machine Company, Boston, Mass., which has many important advantages for mill work, principally its simplicity of construction and convenience of operation. It is, like the others, driven by a constant-speed motor (Crocker-Wheeler), which is here of 10-H.-P. capacity. A wooden belt-enclosure, or guard, is used at this tool to protect workmen from the belt on account of its proximity to the working space at the rear of the tool.

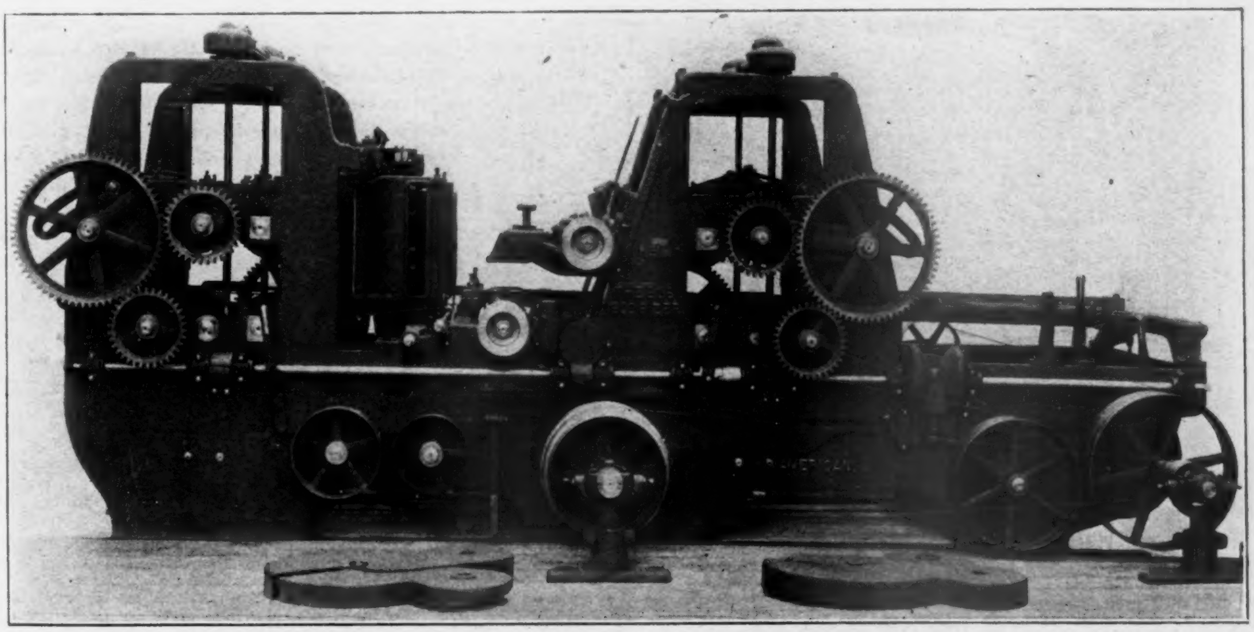
Crocker-Wheeler constant-speed motor, the motor being conveniently located at the rear, outside the fencing; the driving belt passes through an opening in the rear panel to the driving pulley of the machine.

The two following tools, which were supplied by the American Woodworking Machinery Company, New York, are of interest in their use at this shop on account of their strong and efficient, as well as convenient, design. They are, perhaps, the most interesting tools of the shop, as they involve unusual features in many ways. The 4-side sizer is the largest



BELTED DRIVE FOR THE "AMERICAN" PLANER AND MOULDER (AMERICAN WOODWORKING MACHINERY CO.)—20-H.-P. C.-W. MOTOR.

and most rapid machine of this type that is built by the American Woodworking Machinery Company, and is used here for heavy and rapid work in dressing sill stock. It has a capacity for work 30 x 16 ins. in size, and is adjustable for any combination of the four cutting heads; any one may be cut out of service, the side heads being easily swung out of the



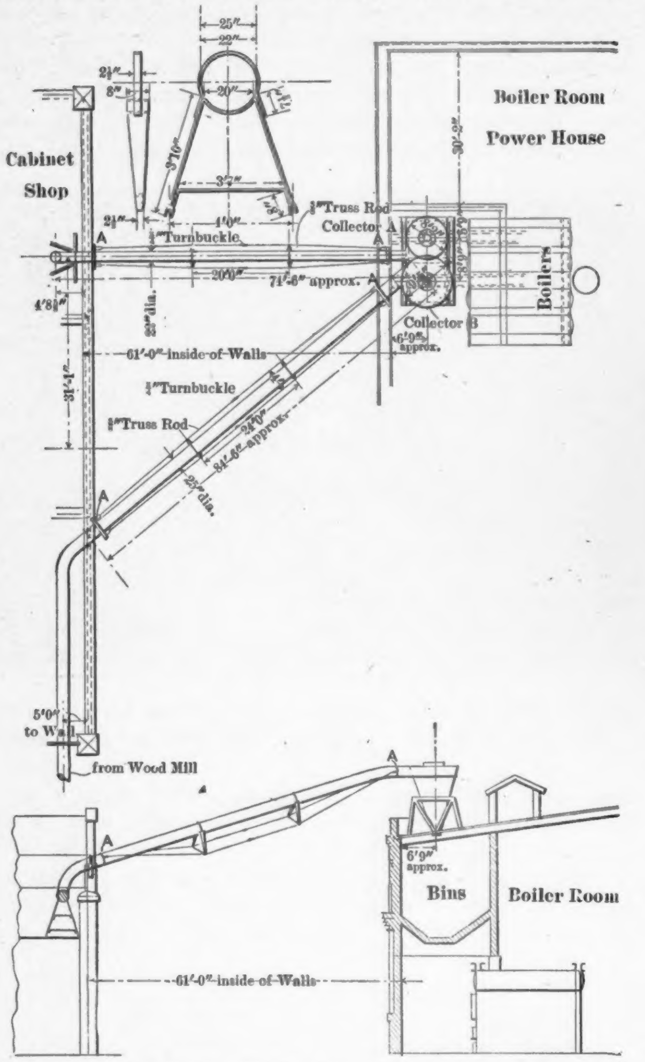
A NEW DESIGN OF 4-SIDE SIZER IN USE AT THE COLLINWOOD MILL.—AMERICAN WOODWORKING MACHINERY CO.

A representative band-saw arrangement may be seen in the next view. The entire tool is fenced in for the protection and convenience of the workmen, which partition is not only of service in case of breakage of the saw, but also serves to retain the sawdust from the table for delivery to the collector-pipe opening, thus assisting in keeping the surrounding floor clean. This tool (No. 335), which was built by the Williamsport Machine Company branch of the American Woodworking Machinery Company, New York, is belt-driven by a 10-H.-P.

way, or replaced by matcher or other style of heads, while the top and bottom cutters are easily raised or lowered by power gearing. The various feeding and other adjustments are complete. This machine, as installed in the wood mill (tool No. 322), is direct-driven by a 35-H.-P. constant-speed motor (Crocker-Wheeler).

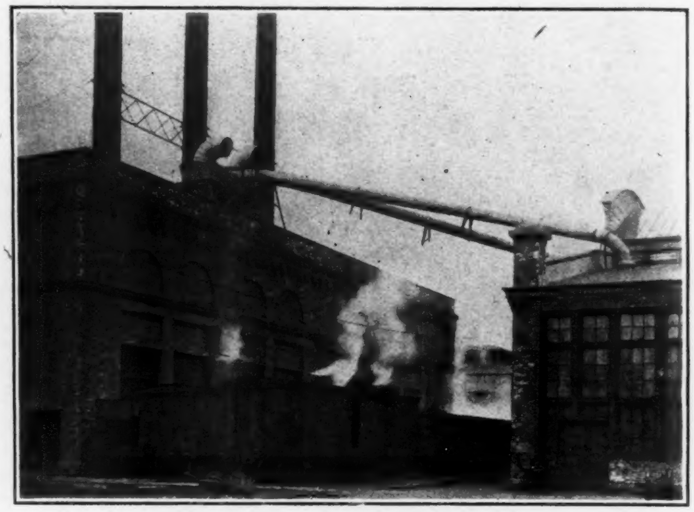
The remaining tool is the "American" planer and moulder, built by the well known Rowley & Hermance branch of the American Woodworking Machinery Company, at Williams-

port, Pa. This tool, which is not shown located in the floor plan of the shop, is driven by a 20-H.-P. constant-speed Crocker-Wheeler motor, located at the right of the tool, at a distance which affords protection from dust and dirt. This tool is an unusually convenient machine to operate, as all adjustments, both vertical and horizontal, are controlled from a plate at the front side of the machine, convenient to the operator. It is also provided with numerous lever adjustments for quickly changing cutter pressures, starting and stopping the machine, etc.

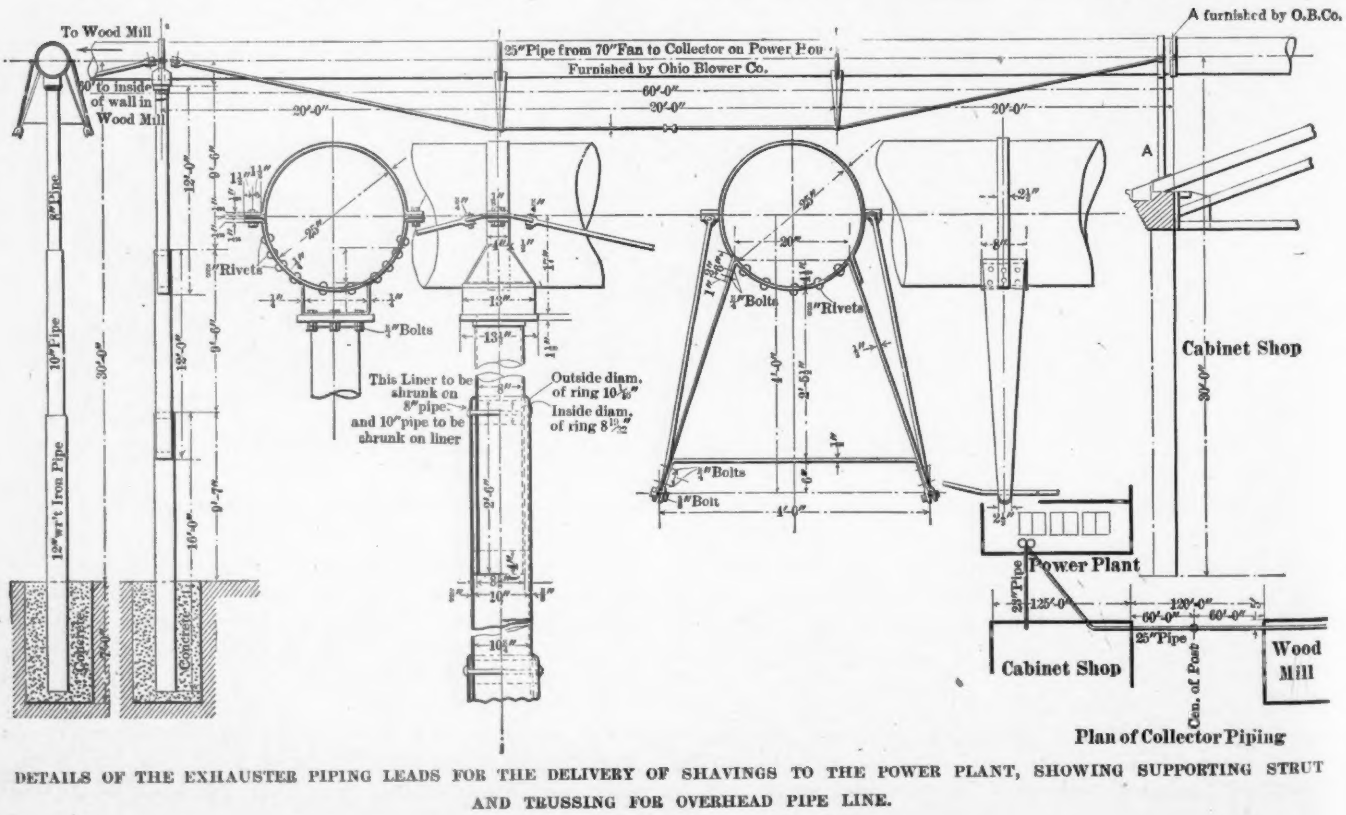


DETAILS OF THE EXHAUSTER-COLLECTOR SYSTEM FOR THE DELIVERY OF SHAVINGS TO THE POWER PLANT FOR FUEL.

A noticeable feature of all these motor-driven equipments is the neat and convenient arrangement of the main controlling switches and starting box for each motor upon a small, hardwood floor-stand at a point near the tool, which is convenient for the operator. These motor-control equipments differ from those used in the main machine shop in that these are operated at constant speeds throughout, for which reason the 4-wire multi-voltage system is not required here. The distribution system is thus greatly simplified, requiring only a 2-wire system of wiring. This system is distributed through the shop from two panel boxes, one of which is shown in the view of the band saw (at the right upon the rear wall). A circuit-breaker in each branch circuit to the machines protects the motors from overloads, while the starting box at each motor is arranged to open the supply circuit in



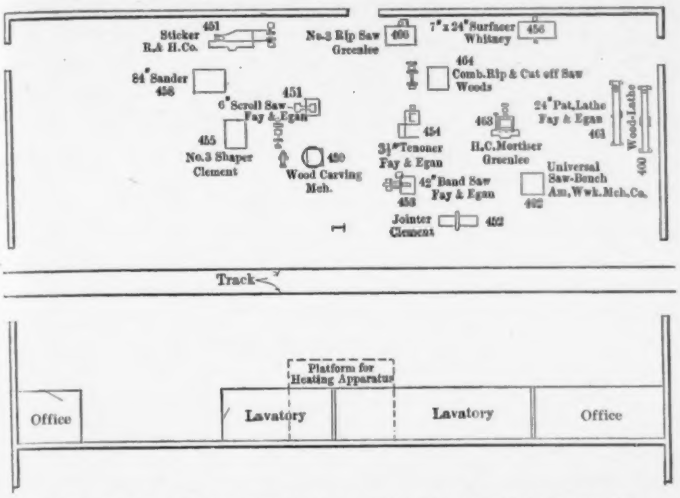
VIEW OF THE EXHAUSTER LEADS DELIVERING SHAVINGS FROM THE CABINET SHOP AND WOOD MILL TO THE BOILER ROOM STORAGE BINS.



DETAILS OF THE EXHAUSTER PIPING LEADS FOR THE DELIVERY OF SHAVINGS TO THE POWER PLANT, SHOWING SUPPORTING STRUT AND TRUSSING FOR OVERHEAD PIPE LINE.

case of no load from the current supply being in any way shut off.

An essential feature of the wood mill is the exhauster collector system, which is installed to remove sawdust from the machines and from the floor as it accumulates, and deliver it to the power plant for use as fuel under the boilers. Two



FLOOR PLAN OF CABINET SHOP, SHOWING ARRANGEMENT OF APPARATUS.

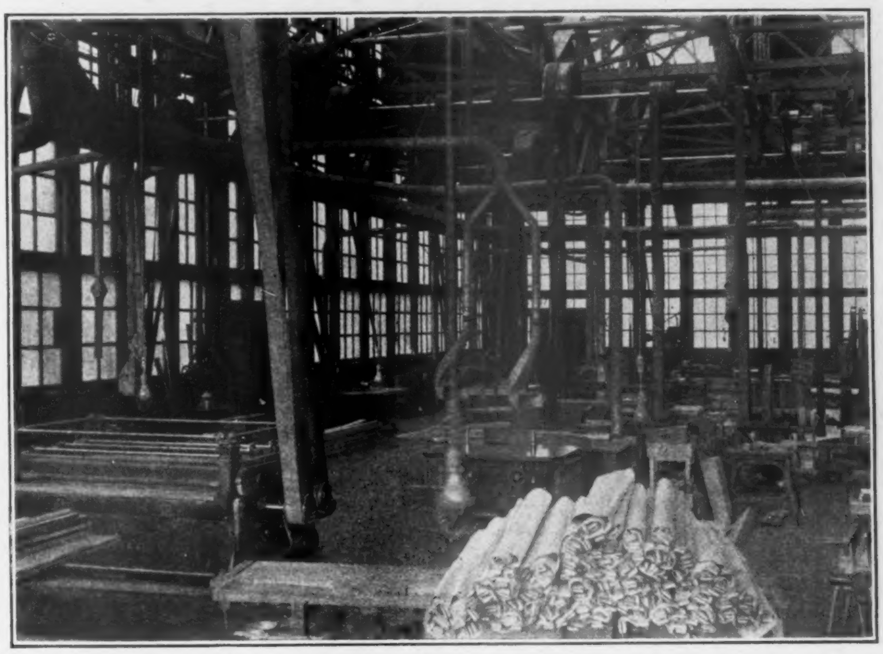
exhauster blowers are used, located inside the wood mill, upon wall brackets, from which suction pipes lead to hoods covering the cutters or saws of the various tools, so as to instantly draw in any chips or sawdust produced; floor sweep openings are also provided at the band saws, boring machines, etc., so that all shavings accumulating on the floor may be raked or swept to them, when they will be drawn away quickly by the suction. With the elaborate provision of a collector-opening at each machine an unusual opportunity is presented for maintaining a cleanly condition in the shop; the unusual advantages to the men resulting from a reduction of dust and the consequently lighter shop will surely make themselves known in the form of increased production. The effectiveness of this system is evident when it is learned that it removes quite large sticks and blocks of wood with the greatest facility.

The accompanying drawings present general details of the connections between the shavings collector at the mill and the storage bins in the boiler room of the power-house, where they are burned for fuel. From the discharge of the centrifugals on the wood mill roof, a 24-in. pipe connection is made, leading to the boiler room exhauster, which removes the shavings to the bins as fast as accumulated. The erection of the connecting pipe presented some difficulties, but these were worked out in the manner shown in the drawings; a special strut in the area between the wood mill and the cabinet shop was used to support the pipe, while from there to the boiler-room roof a truss frame is used. The photograph shows this construction clearly.

The cabinet shop equipment is very complete, as shown by the tool list. It is provided with the best and most efficient tools possible for the work, and is provided with a shavings collector system also, which removes sawdust, chips, etc., from the machines and delivers also into a connecting pipe leading over to the boiler-room. On account of their usually smaller sizes these tools are not individually driven, but are group driven from two line shafts. The effect of overhead belts is not troublesome here on account of the light class of work handled, and also on account of the greater part of the work consisting of bench work. The accompanying photograph shows the interior of this shop.

Jacob N. Barr, assistant to the president of the Chicago, Milwaukee & St. Paul Railroad, died last month at his home in Libertyville, Ill. He was 52 years of age, and was one of the best known motive power officials in the country. He was a graduate of Lehigh University, and began his railroad career at the Pennsylvania shops, at Altoona. He went to the Chicago, Milwaukee & St. Paul in 1886, and was soon placed in charge of the motive power department. Subsequently, he had charge of the motive power department of the Baltimore & Ohio, and later of the Erie, and afterward returned to the Chicago, Milwaukee & St. Paul as general superintendent. He was one of the pioneers in the improvements made in chilled cast iron wheels, and was very active all through his career in developing and improving this part of railroad equipment. His death is a distinct loss to the railroads, and removes an able and intelligent man, whose life stood for uprightness and integrity. It is a loss to an unusually wide circle of friends who were endeared to him by unusual personal traits.

Mr. T. B. Purves, Jr., has resigned as superintendent of motive power of the Boston & Albany Railroad, and is succeeded by Mr. John Howard, formerly division superintendent of motive power of the New York Central & Hudson River Railroad. Mr. Howard is succeeded by Mr. C. H. Hogan, master mechanic of the New York Central at East Buffalo, and



VIEW IN THE CABINET SHOP, SHOWING SHAVINGS COLLECTOR CONNECTIONS.

Mr. Hogan is succeeded at East Buffalo by Mr. William Smith, heretofore master mechanic at Mott Haven, N. Y.

Mr. W. L. Davis has been appointed assistant master mechanic of the Buffalo Division of the Pennsylvania Railroad at Buffalo, N. Y.

Mr. E. H. McHenry, who recently resigned as chief engineer of the Canadian Pacific, and was for nineteen years connected with the Northern Pacific Railroad, has been appointed fourth vice-president of the New York, New Haven & Hartford, with headquarters at New Haven, Conn., where he will have charge of all new construction work.

Mr. W. S. Morris, who recently resigned as mechanical superintendent of the Erie Railroad, was surprised on May 16th by a delegation of his former subordinates, who presented him, as a token of esteem and affection, with a beautiful Turkish chair and a large hall clock. He had been but two years on the road, and in that time had endeared himself to his associates in a way which only men like Mr. Morris can do.

TRACK ARRANGEMENTS IN LOCOMOTIVE SHOPS.

BY C. A. SELEY.

The arrangement of the erecting department of railroad shops has been interesting in the various modifications used to accomplish the purpose of the shop which is to receive the engine, house it during the various operations in dismantling, repairing, erecting and testing. For large shops it is not feasible to use spur tracks for entrance to the pits, and transfer tables or overhead traveling cranes are used for placing the engines. Prior to the common use of cranes, the transfer table was frequently used, serving a transverse arrangement of pits, one of which was usually rigged with a drop table for removing drivers. This use of a pit cut it out from general use so that the engine capacity of the shop in pits should not include the drop pit. This arrangement generally provides certain pits for boiler and tender work and the machine and boiler shop machines are placed back of the engines with a longitudinal track and runway separating the departments. This is a general description of many railroad shops, some with and more without cranes over the engines. The Chicago, Great Western shops at Oelwein, Ia., present an interesting example of the transverse pit arrangement, served by a transfer table, with an overhead crane traversing the erecting shop and the heavy machine tools which has, no doubt, proved immensely valuable in dismantling and erecting work. An electric lift is also used for lifting engines to allow taking out and getting in wheels. This lift runs on the erecting crane runways and is towed to place as required. This arrangement makes every pit available as a working pit, but at times must limit the field of usefulness of the erecting crane. The new Great Northern shop, at St. Paul, is of the same general type, but with a different crane arrangement. Light, hand-operated cranes cover the front ends of engines and a locomotive jib crane back of the engines has a radius of action to carry it within reach of the cranes in front. While these cranes will greatly facilitate erecting operations it is not believed they possess the flexibility and speed of a full overhead crane arrangement. One pit is equipped as a drop table. The Lake Shore & Michigan Southern shops at Collinwood, the Philadelphia & Reading shops at Reading, Lehigh Valley shops at Sayre (under construction) and some others present a modification of the transverse track arrangement by omitting the outside transfer table, using instead a heavy overhead traveling crane with ways sufficiently high to traverse engines over one another. This requires the use of one space for entrance and exit. The usual winter troubles of an outside transfer table with snow and ice are avoided. These cranes are so heavy that they are not useful for comparatively light erecting operations, and lighter capacity cranes are installed for that purpose with separate runways on a lower level. The total investment for such an arrangement is large, as it includes the cost of a heavy crane, which is used only for transferring engines, and may make very few movements per day; also the cost of heavy steel work and walls of very considerable height and the cost of lighter capacity cranes, making this as costly an arrangement as can be put in. Available room and the arrangement of other shops may necessitate the plan just described in some localities, but that it is the best possible arrangement to be had for a given sum of money is a question.

Many roads have erecting shops with longitudinal tracks and pits, and in these one end is frequently used as the boiler shop. In these shops two cranes are necessary in handling engines, one at either end. The center track is generally used for dismantling and also for the wheeling and final erection work, and a pit is needed to facilitate these operations. The engines during repairs are placed on blocking on the side pits, sometimes in a straight line and sometimes on a slight angle, to allow engines to be placed closer together and yet provide room for flue work and cross communication. The pits in the straight three-track shops hinder cross communication unless a number of blanks and crossing planks are provided. Some have questioned the necessity for pits, but it is believed that they are necessary. Without them the engines have to be blocked higher to do the work under them, and this necessitates also blocking up the men to work outside. Many boilers are not removed and need washing out, which would involve transferring during repairs.

Close watching is necessary to prevent pits becoming the repository of junk, scrap and refuse, yet it can be done and the pits kept clean and properly drained with a good sewerage system. With these longitudinally arranged shops we find various modifications in regard to the location of the machine shop. The Norfolk & Western machine shop at Roanoke is a separate building, parallel with the erecting shop, with a number of connecting passages and truck tracks. At Fort Wayne, Ind., the P. R. R. machine shop is at a right angle to the erecting shop, and the runways of the machine shop crane extend within the erecting shop for convenient transfer of heavy articles. The "Santa Fe" at Topeka, the Central Railroad of New Jersey at Elizabethport, Philadelphia, Wilmington & Baltimore at Wilmington, and others, have the machine shop in the same building with tools on one or both sides of the erecting bay.

The designer of the Rock Island system shops at East Moline, Ill., has departed somewhat from all the above described arrangements. The erecting shop begins and ends like the last described shops, with longitudinally arranged pits for dismantling and final erecting work and with a center through track and passage way.

The pits for receiving engines during repairs are at an angle with the center track, or arranged "herringbone fashion" may express it more clearly. The angle of the pits should be such as would be made by an average length engine, hanging from the hooks of two cranes when the cranes are about to approach each other, the trolleys being moved meantime to accommodate the distance between the hooks. A little more skill is necessary in handling the crane for placing an engine in this manner than the straight lift and traversing in the other plans, but experience shows that this is easily attained. While this plan requires a rather daring width of space (95 ft.), advantages which accrue seem to justify the arrangement. Two cranes are used, and when not employed in transferring engines they are available for assistance in erecting, being speedy in traveling and traversing, and having an auxiliary drum and fast hoisting hook for light lifts. Practically 100 per cent. of the erecting shop is under service of these cranes, and if the future develops the need for them, additional cranes can be placed on the runways. Cross communication on the floor is greatly facilitated by the diagonal arrangement of the pits as compared with the straight longitudinal plan. The machine shop is on one side and the boiler and tank shop tools on the other, therefore the matter of cross communication is important. The center track has no pit, except at the ends of the shop beyond the end diagonal pits. The bays on either side of the erecting shop bay have runways, and cranes of various capacities are provided for the various operations carried on in the different sections of the shop.

The day lighting of the erecting shop, a matter of great importance, has been accomplished with a perfectly diffused light without shadows, contributing to the successful operation of what appears to be an ideal shop. The matter of cost is always interesting, and in many cases a vital question. In a building which includes more than one department of locomotive repair work it is not feasible to separate the costs of each, except in the proportion of the respective areas of each department, which does not give an altogether fair comparison.

At East Moline the erecting shop occupies 36 per cent. of the area covered by the one building, which includes also the machine, boiler and tank shops as well as a number of minor departments, such as copper, tin and sheet iron work, air brake, cab, pilot, tender frame and truck work. The cost of the entire building, at the present time the largest individual railroad shop building on record, is less than $1.40 per sq. ft. of area covered. This cost includes not only the walls, roof and floors, but also the crane runways for serving the erecting shop, 50 per cent. of the machine shop and 66 per cent. of the boiler and tank shop, fan houses, heating tunnels and engine pits, and shows a very economical construction.

MALLET ARTICULATED COMPOUND LOCOMOTIVE.

0—6—6—0 TYPE.

BALTIMORE & OHIO RAILROAD.

This locomotive, which will exert a tractive effort of 70,000 lbs. as a compound, and 85,000 lbs. in starting, as a simple engine, is entitled to the distinction of being the most powerful locomotive in the world. This locomotive is designed on the Mallet system, employing the Mellin system of compounding, which has been used so successfully in the Richmond compounds, built by the Richmond Works of the American Locomotive Company. It is intended for very heavy pushing service on mountain grades of the Baltimore & Ohio Railroad, and is the first locomotive of this type to be built for American service. The type has become very popular in Europe for heavy grades and sharp curves. The design merits special attention because in a very large locomotive the work is divided up among four crank pins and four separate valve gears.

The boiler of this remarkable locomotive was illustrated in this journal last month. Through the courtesy of Mr. J. E. Muhlfeld, general superintendent of motive power of the Baltimore & Ohio, and the American Locomotive Company, builders, a photograph, general drawings and additional information are now presented, and further description and illustrations will be presented later.

ARTICULATED COMPOUND LOCOMOTIVE.

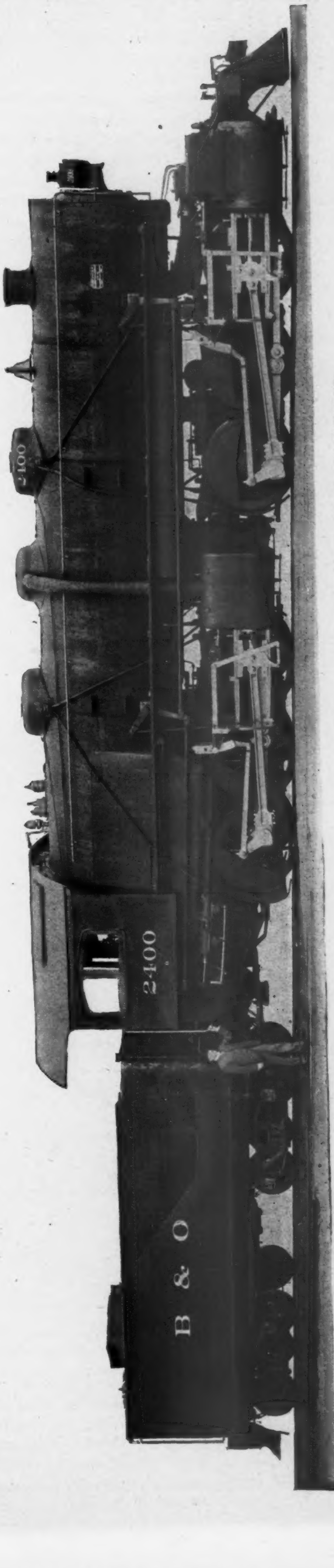
MALLET 0—6—6—0 TYPE.

RATIOS.

Heating surface to volume of high-pressure cylinders	471.6
Tractive weight to heating surface	59.89
Tractive weight to tractive effort	4.78
Heating surface to grate area	77.7
Tractive effort × diameter of drivers to heating surface	700
Tractive effort to heating surface	12.5
Heating surface to tube heating surface	1.4
Heating surface to firebox heating surface	25.4
Tube heating surface to grate area	74.5
Tube heating surface to firebox heating surface	24.4
Firebox heating surface to grate area	3.04

GENERAL DIMENSIONS.

Gauge	4 ft. 8½ ins.
Service	Heavy freight
Type	Mellin compound
Fuel	Run-of-mine bituminous
Cylinders, diameter	High-pressure, 20 ins.; low-pressure, 32 ins.
Cylinders, stroke	32 ins.
Driving wheels, number	12
Driving wheels, diameter over tires	56 ins.
Boiler pressure	235 lbs.
Weight on drivers	334,500
Weight, total	334,500
Weight, tender (with 13 tons coal and 7,000 gals. water)	143,000
Weight, total, of locomotive	477,500
Clearance, height	15 ft.
Clearance, width	10 ft. 6 ins.
Wheel base, rigid	10 ft.
Wheel base, total, of engine	30 ft. 8 ins.
Wheel base, total, of tender	20 ft. 2 ins.
Wheel base, total, of locomotive	64 ft. 7 ins.
Length of locomotive over all	80 ft.
Length from pilot to friction casting	51 ft. 5½ ins.
Height of center of boiler above rail	10 ft.
Main rods, length	9 ft. 7¼ ins,
Driving journals	9 x 13 ins.
Crankpins, main	6½ x 7 ins.
Crankpins, main side-rod	7¼ x 5 ins.
Crankpins, intermediate	5 x 4½ ins.
Crankpins, front	5 x 3¾ ins.
Pistons, thickness	High-pressure, 5⅞ ins.; low-pressure, 5¼ ins.
Piston-rods, diameter	3¾ ins.
Piston packing	Cast-iron rings
Piston-rod packing	U. S. metallic
Valve gear	Walschaert
Valves, kind, high-pressure	10-in. piston
Valves, kind, low-pressure	Double-ported slide
Valves, travel of	6 ins.
Valves, outside lap	High-pressure, 1⅛ ins.; low-pressure, 1 in.
Valves, inside clearance	High-pressure, ¼ in.; low-pressure, ¼ in.
Valves, lead of, in full gear	High-pressure, ⅛ in.; low-pressure, ⅛ in.
Steam ports	High-pressure, 1¾ x 23½ ins.; low-pressure, 2⅜ x 20 ins.
Exhaust ports	High-pressure, 1¾ x 23¼ ins.; low-pressure, 3 x 20 ins.
Bridges, width, low-pressure	1¼ ins.
Boiler, style	Straight top
Outside diameter first ring	84 ins.
Outside diameter largest ring	88 ins.
Outside diameter dome	31 ins.
Height over crown	22 ins.
Firebox, leng., 108 ins.; width, 96 ins.; depth, front, 80 ins.; back, 72 ins.	
Plates, sides, back, crown, tube sheets	⅜, ⅜, 7-16, ½ in.
Water space	Front, 6 ins.; sides and back, 5 ins.
Tubes	Thickness, No. 11; number, 436; diameter, 2¼ ins.; length, 21 ft.
Heating surface:	Tubes, 5,366 sq. ft.; firebox, 219 sq. ft.; total, 5,585 sq. ft.
Grate area	72 sq. ft.
Tender—Weight loaded	143,000 lbs.
Capacity	Coal, 13 tons; water, 7,000 gals.
Construction	Steel frame
Trucks	B. & O. diamond



MALLET ARTICULATED COMPOUND LOCOMOTIVE.—BALTIMORE & OHIO RAILROAD.

AMERICAN LOCOMOTIVE COMPANY, SCHENECTADY WORKS, *Builders.*

J. E. MUHLFELD, *General Superintendent Motive Power.*

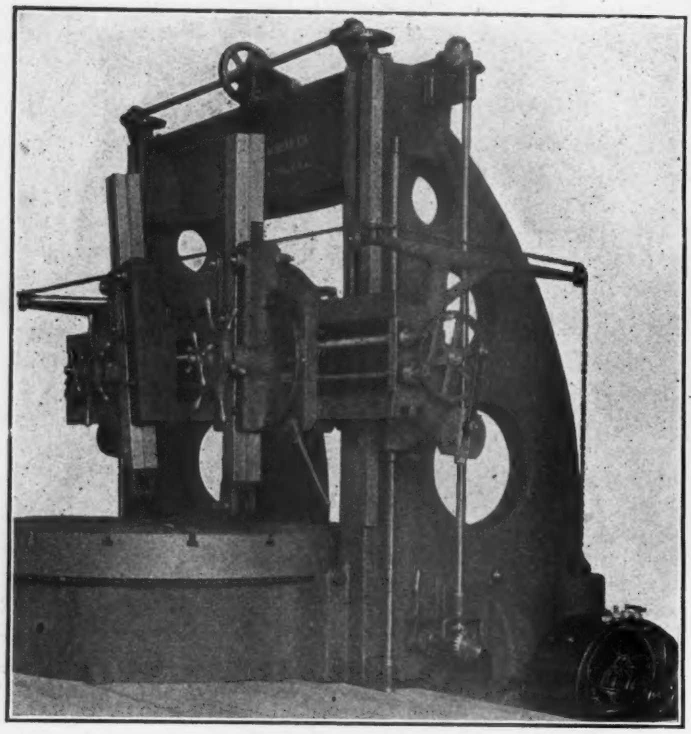
The Largest and Most Powerful Locomotive in the World.

(FOR ELEVATION AND SECTIONS OF THIS LOCOMOTIVE SEE PAGE 218.)

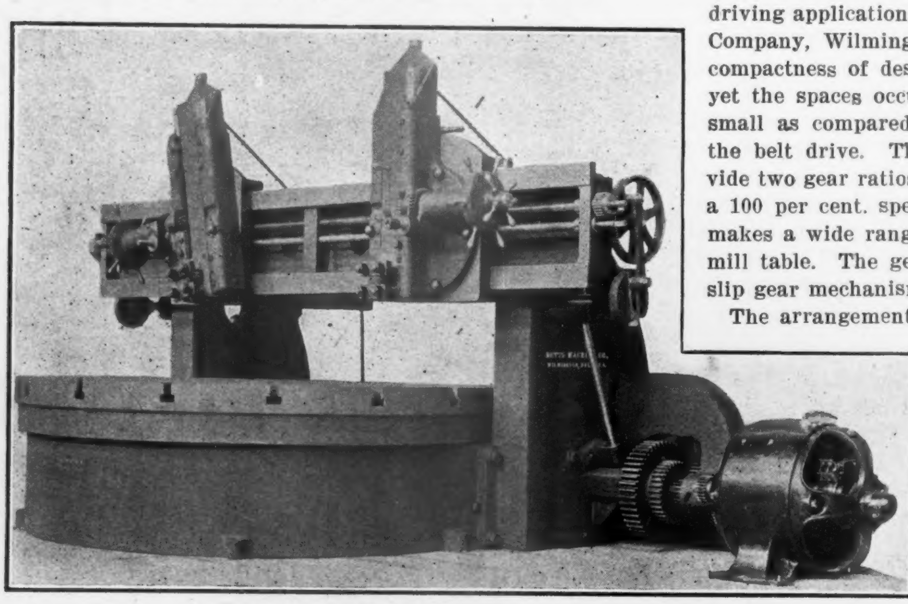
MOTOR-DRIVEN MACHINE TOOLS.

THE DEVELOPMENT OF METHODS OF INDIVIDUAL MOTOR-DRIVING FOR BORING MILLS.

There have been many important improvements and distinct advances made in the development of methods of electrically driving boring mills during the past year. The increasing importance of the boring mill as a machine tool for general shop work has caused as much thought to be devoted to methods of driving it as has been the case with the lathe. In fact, the boring mill is rivalled only by the lathe and milling machine in range and variety of work which may be brought



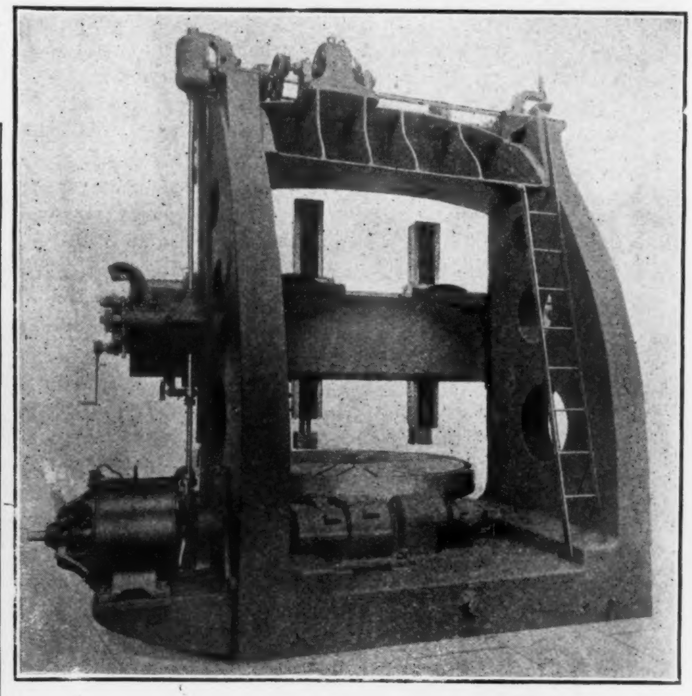
CHANGE GEAR MOTOR DRIVE UPON A LARGE BETTS BORING MILL.—VARIABLE-SPEED GENERAL ELECTRIC MOTOR.



COMPACT GEAR DRIVE UPON A LARGE SPECIAL BORING MILL.—BETTS MACHINE COMPANY.—VARIABLE-SPEED GENERAL ELECTRIC MOTOR.

upon it, so that refinements of speed variation offered by individual motor-driving are of as great advantage as upon the lathe. Especially in railroad repair shop work is the importance of advantageous driving arrangements for the boring mill coming to be recognized.

A year ago, in our June, 1903, issue, an article was presented illustrating some approved arrangements of motor-driving for use upon boring mills. In this article it is intended to indicate the lines along which progress has been made during the past year. It is of importance to note that there is a growing conviction among railroad repair shop men that variable speed driving for this class of tools is essential in obtaining the maximum efficiency and output from them. It is, of course, true that the constant speed drive is still much in evidence, with the entailed use of cone pulleys for variations



COMPACT ARRANGEMENT FOR A BULLOCK MULTIPLE-VOLTAGE SYSTEM VARIABLE-SPEED DRIVE UPON A 10-FT. BORING MILL.—BULLARD MACHINE TOOL COMPANY.

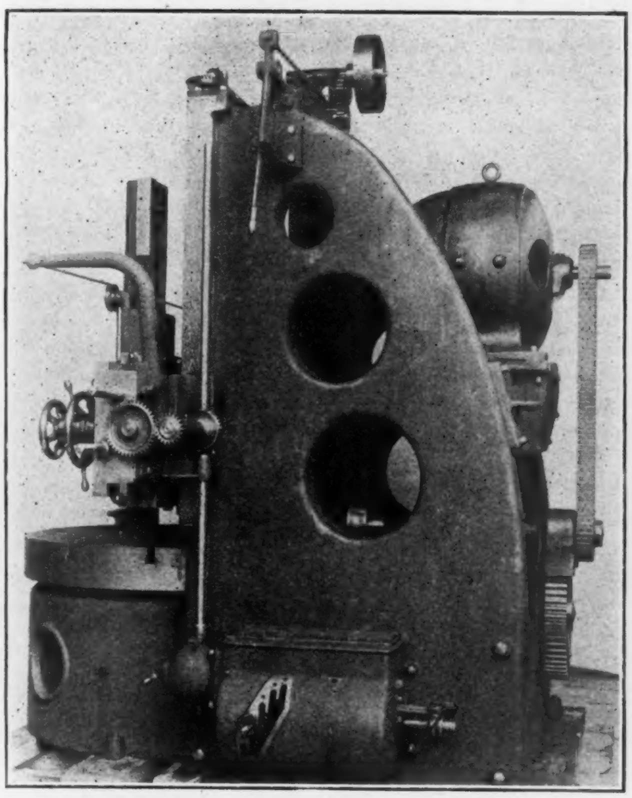
of driving speed, but that this older method is being worked away from by the machine tool builders, may be seen by reference to the accompanying engravings.

In the first two views are illustrated examples of motor-driving applications to boring mills built by the Betts Machine Company, Wilmington, Del., which are remarkable for their compactness of design. These are both very large tools, and yet the spaces occupied by the driving mechanisms are very small as compared with that which would be required with the belt drive. The driving mechanism is arranged to provide two gear ratios, in either of which cases, supplemented by a 100 per cent. speed variation at the motor by field control, makes a wide range of speed changes available at the boring mill table. The gear changes are, in this case, effected by a slip gear mechanism, which is easily handled by the operator.

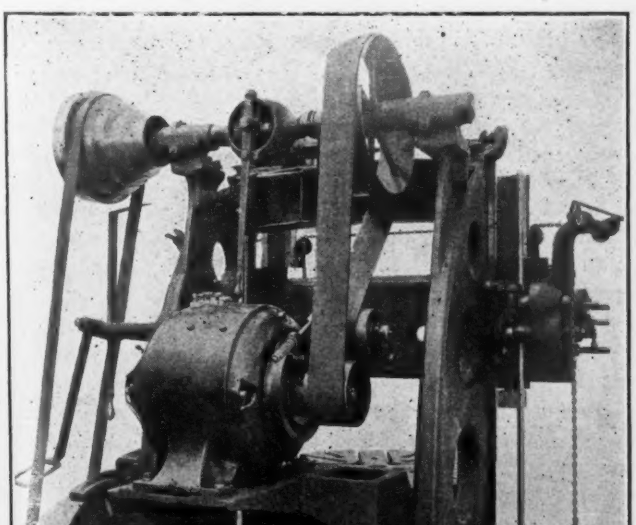
The arrangement of the motor is, in either case, here very easily taken care of, as it can be mounted upon the floor or above or below, in any way, so that its pinion will meet with the reducing gear. In one of these illustrations the motor may be seen arranged upon the floor level, while in the other it is below. The details of the drive of each of these two machines are identical. The motors are the well-known multi-polar direct current motors of the General Electric Company, Schenectady, N. Y., which operate at variable speeds by field control.

In the next illustration may be seen an important example of variable speed driving for the boring mill. This tool is the 10 ft. rapid-production boring mill, built by the Bullard Machine Tool Company, Bridgeport, Conn., equipped with their new variable speed gear drive box, which, in connection with the variable speeds made available at the motor, provides a

wide range of gear changes for speed changes at the table. A wide range of speed changes is available at the motor by means of the multiple-voltage system, for which the motor is equipped. The motor used in this case is the type N four-voltage, variable-speed motor, built by the Bullock Electric Manufacturing Company, Cincinnati, Ohio.

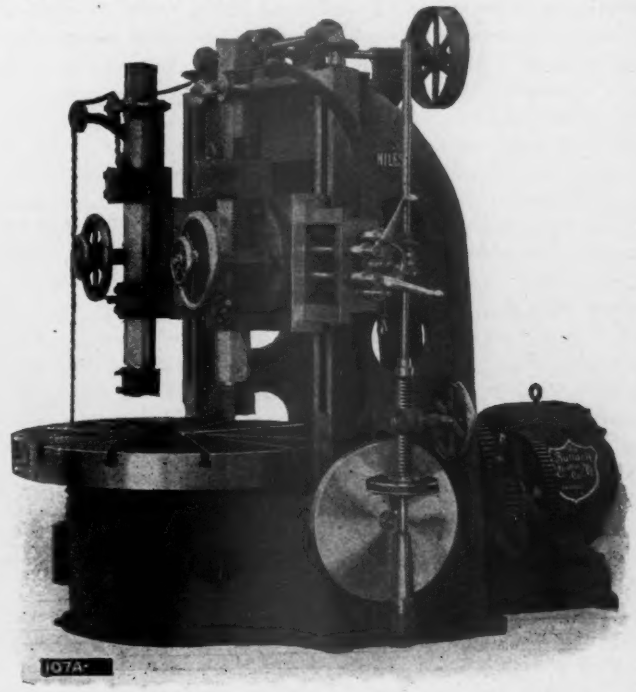


SPECIAL DESIGN OF MOTOR DRIVING EQUIPPED FOR THE M'KEES ROCKS SHOPS (P. & L. E. R. R.) BY THE BAUSH MACHINE TOOL COMPANY.—CROCKER-WHEELER MULTIPLE-VOLTAGE MOTOR EQUIPMENT.

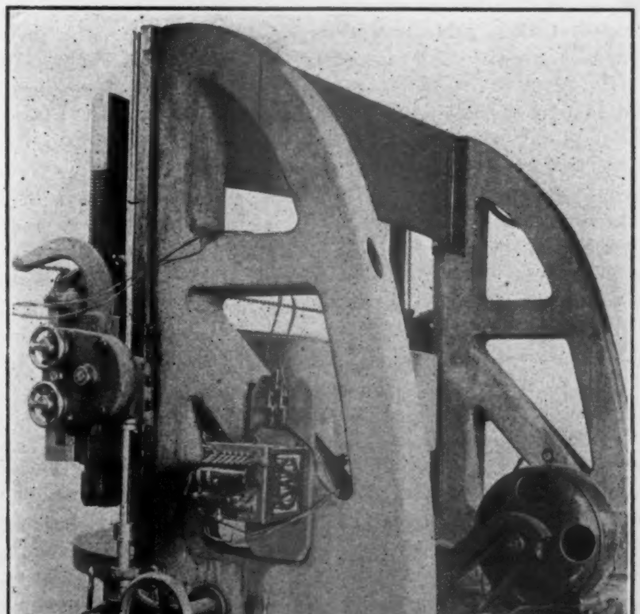


CONSTANT-SPEED DRIVE APPLIED TO A 51-INCH BULLARD BORING MILL.—GENERAL ELECTRIC MOTOR WITH BELT TIGHTENER.

The motor is, here, conveniently mounted for connection to the drive, upon a cast iron bracket at one side of the housing, from which location it drives direct through reduction gearing. Two changes of gear ratios are provided in the gear-box mechanism in the drive of the tool, which are easily controlled by levers near the motor. The effect of this combination is to make a driving arrangement of unusual convenience and compactness for the large size of this tool. It indeed requires less space than would be necessary for this purpose if belt-driving were used.



GEARED VARIABLE-SPEED DRIVE UPON A 51-INCH NILES BORING MILL. —BULLOCK MULTIPLE-VOLTAGE SYSTEM MOTOR.



CONSTANT-SPEED (CROCKER-WHEELER) MOTOR DRIVE UPON THE NEW DESIGN OF BORING MILL OF THE J. MORTON POOLE COMPANY.

In the following engraving is illustrated another interesting type of variable speed drive for the boring mill. This is the 51-in. boring mill, which was equipped especially for motor-driving by the Baush Machine Tool Company, Springfield, Mass., for the McKees Rocks Shops of the Pittsburg & Lake Erie Railroad. This drive embraces an interesting arrange-

ment of the motor in its mounting upon a cross-bracket between the two housings at the rear of the tool; no more compact or advantageous arrangement could have been provided on account of both the directness of the drive and also the removal of the motor from the range of dirt and chips, which is usually found in floor mounting conditions.

The drive of this tool is through a special back gear, which provides two runs of speed, easily controlled from the side of the tool. Connection is made from the motor to the driving gear through a Morse silent chain. The driving-motor is a 15-h.p. Crocker-Wheeler multi-voltage variable speed motor.

In another illustration is shown the application of another multiple-voltage variable-speed drive to a Niles boring mill, in which a floor arrangement of motor is provided for. The motor is here direct connected to the drive by gearing, which has two runs for additional speed changes. The resulting arrangement thus effected is very compact and convenient. This motor is the type N multiple-voltage motor, built by the Bullock Electric Manufacturing Company, Cincinnati, Ohio.

The two remaining engravings illustrate representative types of constant speed drives, as applied to the boring mill. The first tool is the new mill of the J. Morton Poole Co., Wilmington, Del., which is equipped with a change gear mechanism in the drive for obtaining variable speeds, and makes it serviceable where variable speed motors are not to be had. Three changes of speed are available in this gearing by manipulation of a lever at the right side of the tool, thus offering a fair speed range, which can be met by the variable feeding speeds provided in the feed box.

The motor is mounted upon the bed of the tool at the rear between the housings, and drives through a silent chain. It is controlled by a starting box located conveniently upon the right housing for the operator. With this arrangement the motor is made most accessible for attention and care.

The other view illustrates one of the designs of constant speed drive that is used by the Bullard Machine Tool Company, Bridgeport, Conn., this arrangement being that applied to their 51-in. boring mill. The noticeable feature of this arrangement of driving is the convenient location of the motor upon the cross bracket between housings at the rear. It is thereby raised up out of the dirt and dust that is inevitable near the floor. The drive is made by belt to a counter-shaft, conveniently located at the top of the housings, from which the drive to the lower shaft and back gearing of the table drive is made through cone pulleys and belt. The motor used in this case is the special type of direct-current motor of the General Electric Company arranged with belt tightener, which is used in the manner shown. This makes adjustments convenient and renders the arrangement very serviceable.

AIR BRAKE CONVENTION.

One of the most important reflections from the convention of the Air Brake Association, held at Buffalo last month, was the necessity for higher brake power for freight cars. It was proposed in a paper by R. H. Blackall that the brake power should be increased from 70 to 90 per cent. of the light weight of cars, and that a cylinder pressure of 60 lbs. for emergency application should be provided. The increased attention given to the handling of air brakes, together with the tendency toward the use of hard brake shoes, renders this change possible. An important paper by Mr. F. M. Nellis, secretary of the association, suggested that instead of arranging the braking power of passenger cars on a percentage basis that it should be based upon the dead weight carried per axle, because of the large variation of weight of passenger cars. When figured on a percentage basis the light cars in the train produce the greatest braking effect, in proportion to their weight, and are consequently likely to slide the wheels. Mr. Nellis supported his recommendation from the results of tests made on the New York, Ontario & Western Railroad, where, by arranging the braking as suggested, he reduced the sliding of the wheels and avoided the surging of the train by making each car do its share of the work of braking. The opinion that it is possible to increase train pressure of freight trains to 90 lbs. was generally supported at this convention.

COLE'S FOUR-CYLINDER BALANCED COMPOUND LOCOMOTIVE.

NEW YORK CENTRAL & HUDSON RIVER RAILROAD.

This locomotive was illustrated on page 166 of our May issue. Additional engravings are now presented, together with the following description by the designer, Mr. F. J. Cole, mechanical engineer of the American Locomotive Company:

Owing to the satisfactory performance abroad of the four-cylinder balanced compound it seemed desirable to make a design embodying all the essential elements, but simplifying the construction to suit American requirements. With this in view the two cylinder single-expansion New York Central Atlantic was selected as the type which, without any radical changes in wheel base, boiler, etc., would be the most likely to give the best results. These engines possess many desirable features for heavy, high speed passenger service on roads of moderate grade. Their great steaming capacity, deep fire boxes, ample grate and fire box areas render them capable of sustaining high horse-power. Tests show that they have developed from 1,400 to 1,500 indicated horse-power for continuous effort.

The advantageous features of the four-cylinder balanced compound engines are:

(a) Balancing of reciprocating parts by similar horizontal moving parts. One outside piston and its attachments moving forward while the inside one is moving backward. These exactly balance one another without the use of unbalanced weights in the wheels.

(b) The increase of weight permissible on the driving wheels when considered dynamically. In the ordinary engine, at 60 miles per hour, with drivers 78 ins. in diameter, the increase or decrease at each revolution of the static weights on the rail is about 23 per cent. This is due to the centrifugal effect of the excess weights used to balance the reciprocating parts.

(c) Increase of from 25 per cent. to 33 per cent. in sustained horse-power at moderate and high speeds without any material change in size or style of boiler.

(d) Economy in the use of fuel, water and steam.

(e) The sub-division of power on two axles and four cylinders. Reduction of bending stresses on the crank axle due to the fact that only half the turning moment is transmitted through each axle. The advantages from light moving parts, such as cross-heads, main rods, piston rods, etc. The lightness of these parts permits them to be easily handled, and the probability is, as they have to transmit only half the usual amount of power, that the wear and repairs will be greatly decreased.

(f) Simplicity in design. One set of valve gear with comparatively few parts when compared with the foreign designs.

The boiler is identical with the present Atlantics, with the exception of 3 ins. increase in length of barrel, due to the extra amount of clearance required between the low-pressure cylinders and engine truck wheels. The high-pressure cylinders are placed ahead of the low-pressure cylinders with the guides and crossheads under the low-pressure cylinder saddle so as to obtain sufficient length of main rods. Otherwise the high-pressure rods would be abnormally short in comparison with the low pressure, which would result in too great angularity of the rods, excessive strains in the guides and crossheads and unsatisfactory distribution of steam.

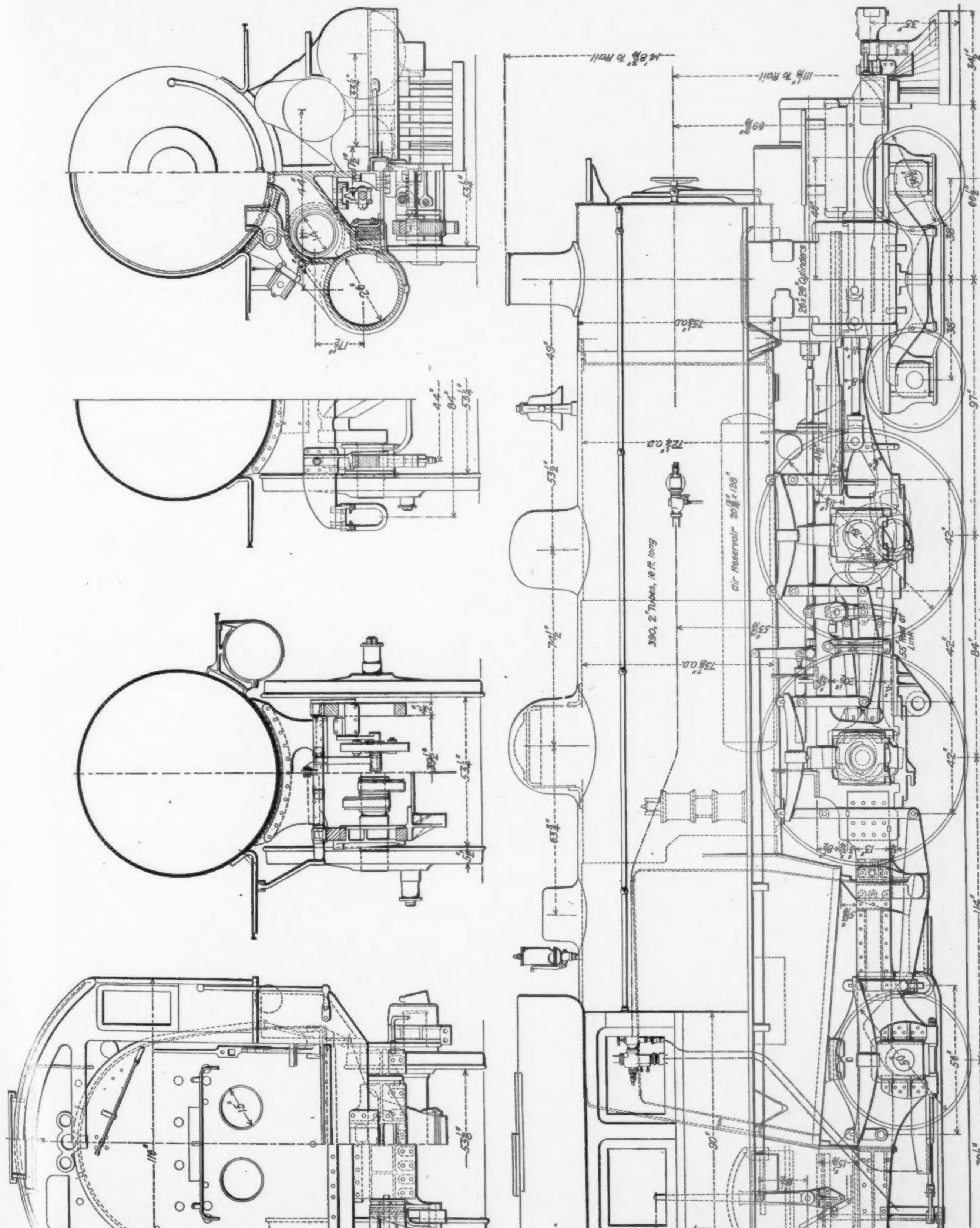
The valve gear is of the usual American type of Stevenson link motion, with reversing rocker and straight eccentric rods. The valves are 14-in. hollow piston type, four in number, identically the same and of extremely light construction. Two are used on each side on the same stem, the high-pressure ones being central admission and the low-pressure outside admission.

Preliminary tests show that this compound engine is capable of developing from 1,900 to 2,000 indicated horse-power, 1,980 having actually been obtained at 75 miles per hour, 1,68[illegible] at 67 miles per hour, and 1,680 at 84 miles per hour.

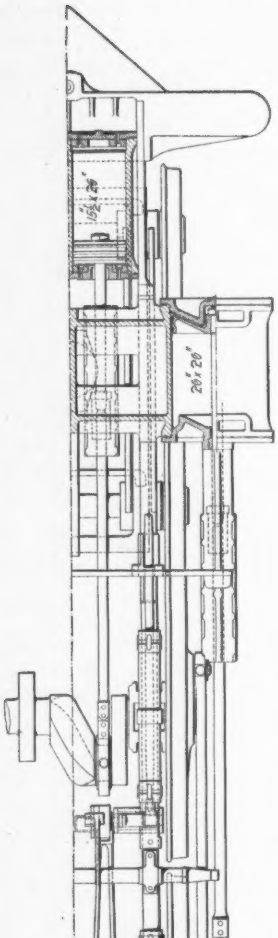
RATIOS, COLE'S FOUR-CYLINDER BALANCED COMPOUND.

Heating surface to cylinder volume (high pressure)	609
Tractive weight to heating surface	31.9
Tractive weight to tractive effort	4.58
Tractive effort to heating surface	6.96
Heating surface to grate area	68.5
Heating surface to tractive effort	14.3
Total weight to heating surface	58.03
Tractive effort × diameter of drivers to heating surface	1134

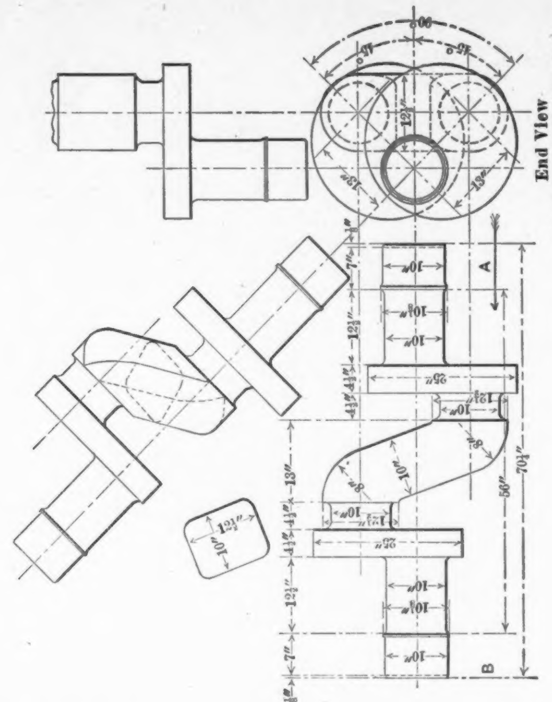
This locomotive will be tested on the locomotive-testing plant at St. Louis, and will form part of the exhibit of the New York Central at the World's Fair. It will afterward be put into regular passenger service on the New York Central. Several weeks of regular service indicate that the engine will be satisfactory from every standpoint.



COLE'S FOUR-CYLINDER BALANCED COMPOUND LOCOMOTIVE.— NEW YORK CENTRAL RAILROAD.



PLAN OF RUNNING GEAR AND CYLINDERS.



CRANK AXLE.

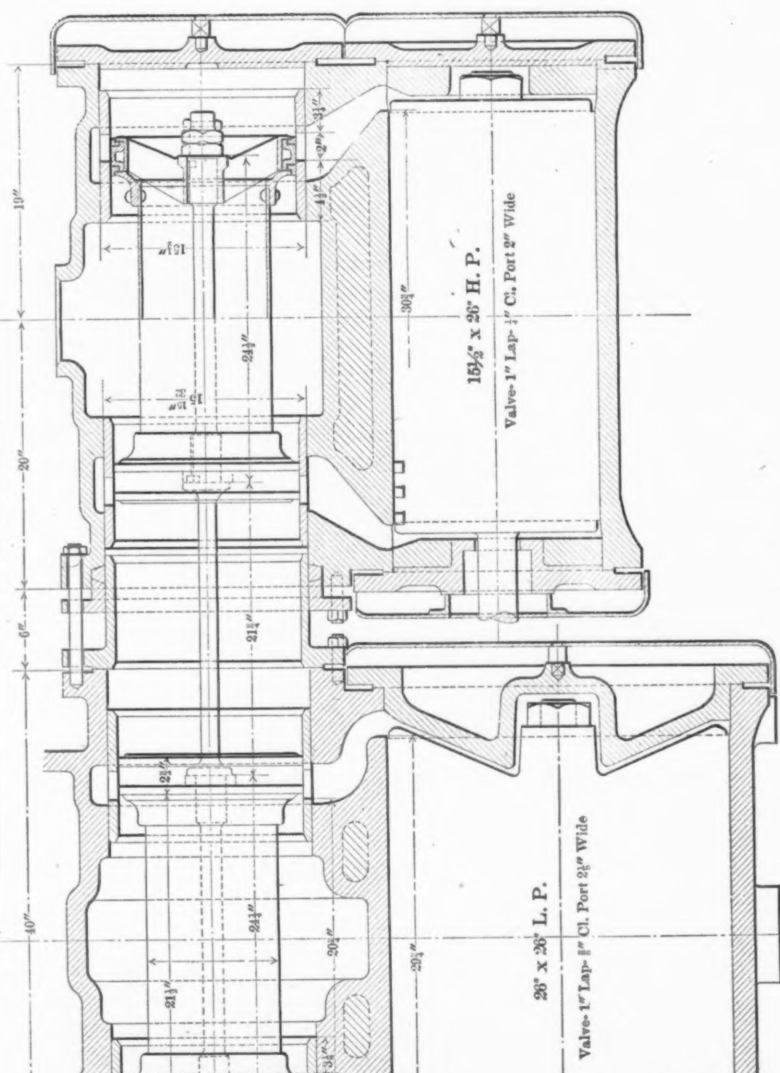


DIAGRAM OF VALVES AND CYLINDERS.

COLE'S FOUR-CYLINDER BALANCED COMPOUND LOCOMOTIVE.—NEW YORK CENTRAL RAILROAD.

A NEW SEMI-RADIAL DRILL.

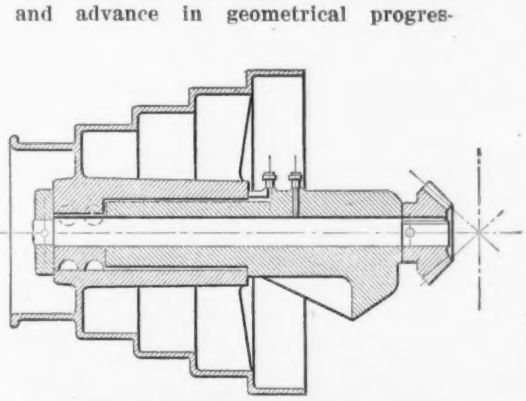
BICKFORD DRILL AND TOOL COMPANY.

A radical and interesting design of drilling machine has recently been developed and placed upon the market by the Bickford Drill and Tool Company, Cincinnati, Ohio, the well-known builders of heavy duty and rapid production machine tools. This tool is of an unusual design, which they term "semi-radial," the intention being to produce a tool of great rigidity and simplicity, which will be particularly serviceable for many classes of work. It will be received with interest by a large number of machine tool users who require very heavy and stiff tools in their rapid machining processes.

The criticism that would naturally be turned against the use of an overhanging cone, such as is here made use of at the top of the column, will be dispelled after a study of the extremely long and rigid bearing which is used for that cone. This bearing is shown in the accompanying sketch, from which may be seen the stiff and substantial character of this novel arrangement. The cone pulley has its bearing upon the outside of the overhanging arm, while the driving shaft extends through it to the other side, being connected to the hub by means of a special collar, as shown.

The chief characteristics of this machine are rigidity, simplicity and durability, which, combined with a high ratio of transmission gears, make it an admirable tool for many classes of work. The head, on which all bearings are of uncommon length, consists of a single casting and is adjustable on the arm by means of a spiral gear which gives it an easy, quick motion. The spindle is made of hammered steel and has an unusually great vertical adjustment for a machine of its size. It is provided with both hand and power feed, and a quick advance and return. The feeding mechanism furnishes three rates of feed, advancing by even increments from .008 in. to .016 in. per revolution of spindle, each of which is instantly available by means of a shifting key.

The driving mechanism contains but seven gears, the pitch and periphery speed of which are conducive to long life. The speeds are five in number and advance in geometrical progression from 50 to 170 revolutions per minute. The frame may be said to consist of but five parts, the base, column, cap, arm and arm shaft, each of which are commensurate with the continuous severe work which may be expected of a machine of this character.

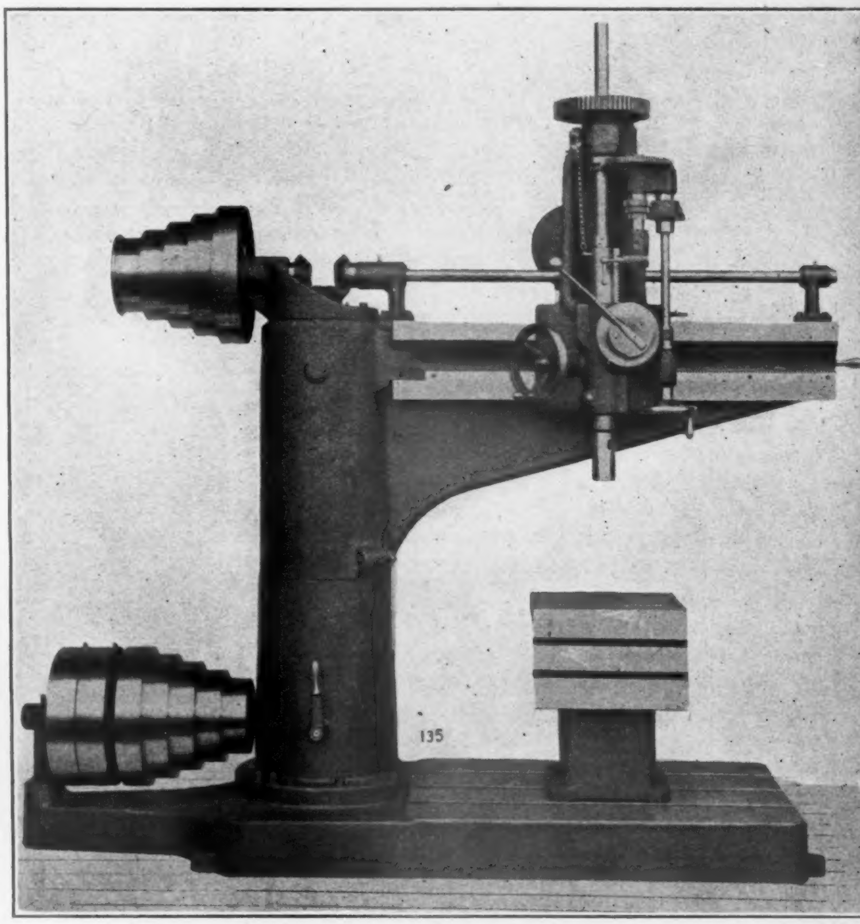


BEARING OVERHANGING CONE PULLEY.

GENERAL DIMENSIONS.

Diameter of spindle, least section	1 13-16 ins.
Traverse of spindle	18 ins.
Horizontal range of head	3 ft. 6¾ ins.
Receives under spindle over table	24 ins.
Receives under spindle over base	4 ft.
Receives under spindle over floor	4 ft. 7 ins.
Drills work in plane of base to center of	8 ft.
Size of table, working surface	20 x 20 ins.
Size of base, working surface	3 ft. x 4 ft. 1 in.
Distance from floor to extreme height of spindle	9 ft. 4¼ ins.
Number revolutions of driving pulley to one revolution of spindle	6:9
Maximum diameter of driving cone	18 ins.
Width of cone belt	3 ins.
Speed of countershaft	350 revolutions
Floor space required	9 ft. 3 ins. x 11 ft. 9 ins.
Weight, net	6,500 lbs.

Mr. B. E. Stevens has been appointed general foreman of the locomotive department of the Illinois Central at the Burnside shops, to succeed Mr. George J. Hatz, recently resigned.



THE NEW DESIGN OF BICKFORD "SEMI-RADIAL" DRILL WHICH HAS BEEN DESIGNED FOR HEAVY AND EXACTING SERVICE.

Mr. K. Trowbergh has been appointed superintendent of shops of the Great Northern Railway, at Everett, Wash., to succeed Mr. John Dickson, who was recently transferred to Larimore, N. D., as master mechanic.

Mr. Nelson M. Maine has been appointed district master mechanic of the northern district of the Chicago, Milwaukee & St. Paul Railway, with office at Minneapolis, Minn., to succeed Mr. John Taylor, resigned.

Mr. James A. Hinson, president of the National Car Coupler Company, of Chicago, and widely known as an inventor of car coupling devices, died in Chicago, May 12. He was 52 years of age and had spent the whole of his business career in connection with railroad supplies. He brought out a large number of important inventions, and was one of the best authorities on all subjects connected with car coupling devices.

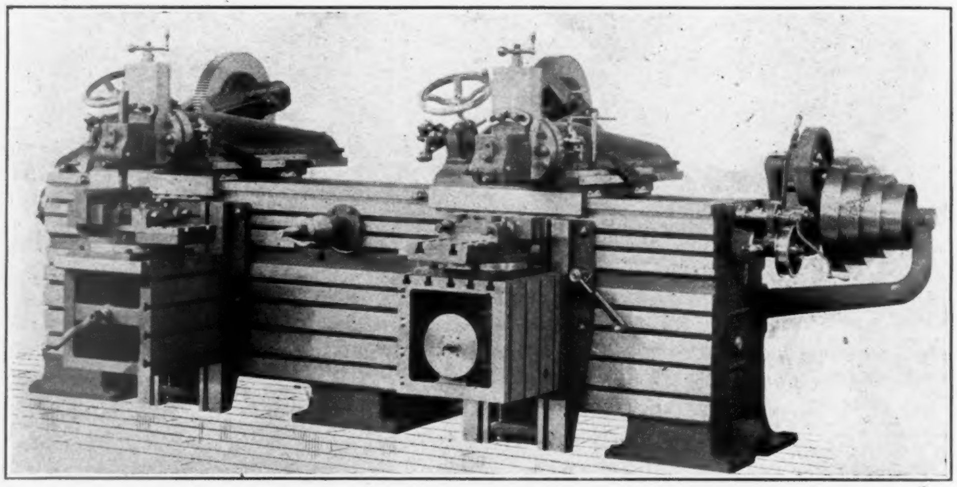
Mr. A. W. Whiteford, heretofore piece work inspector at the new Omaha shops of the Union Pacific Railroad, has been appointed superintendent of locomotive and car shops on the Nebraska division of this road, reporting directly to the superintendent of motive power. Mr. Whiteford served as a special apprentice on the Burlington, and afterward acted as piece work inspector of this road at St. Joseph, Mo. He went to the Union Pacific eighteen months ago, and has earned his promotion through the remarkable net saving resulting from the shop operations which have been under his charge.

A NEW DESIGN OF SHAPER—THE "PULL CUT."

CINCINNATI SHAPER COMPANY.

One of the most important changes that has taken place in metal working machinery design of recent years is evidenced in the accompanying engraving—the development of the "pull cut" idea for shapers. The Cincinnati Shaper Company have taken this important step in design with a view of bringing their tools to a position in advance of the pace that has been set by the use of the new high-speed tool steels, and in no other way could this have been done more effectively. There has been a growing opinion among machine tool users for some time past that the "pull cut" offers many advantages over the older style of push cut, and this new design will do much toward filling this demand.

The tool here illustrated is the 24 in. x 12 ft. Cincinnati traverse shaper, with two heads, each of which is equipped for the "pull cut." The difference between this and the ordinary type of traverse shaper is that the cutting tools are reversed, the cutting taking place during the backward motion of the ram and quick return during the forward, the operation being thus directly opposite to that in the usual type of shaper.



THE NEW "PULL-CUT" SHAPER RECENTLY INTRODUCED BY THE CINCINNATI SHAPER COMPANY.

The advantage of this type is that the pressure or thrust of the tool is taken directly back against the bed of the machine, and tends to draw the table and apron more closely to the bed, rather than force them apart, as is the case with all push-cut shapers. This is of a decided advantage, especially when heavy cutting is being done, as is the case since the introduction of high-speed tool steels. Then, in many cases, the work itself can be pressed directly against the bed of the machine, so that the resistance to the cutting is not all together dependent upon the hard clamping of the work and the table. Large pieces can also be advantageously bolted to the bed, the tables being removed; this is of considerable advantage in certain classes of work.

The head is so constructed that the stress due to the cut comes directly upon solid metal contacts, and not upon threads, bolts or screw points, except in the case of the set screws for holding the tool. These screws are large in diameter, and have a long bearing. The whole construction of the head is one of great rigidity and strength, having the least possible tendency to yield or spring under the cutting strain. Except for the head, ram and such other modifications as have been found necessary, this traverse shaper is similar to the ordinary push-cut machine heretofore and still built by the Cincinnati Shaper Company, the introducers of this type of tool.

RELIABILITY OF GAS ENGINES.—A 400-H.P. gas engine has been run for 98 per cent. of the total number of hours in one year without stopping, and the idle 2 per cent. was made necessary by adjustment of the dynamo to which it was coupled. In another case four engines of 450-H.P. each have been run six months without stopping. These facts are cited in an article in *The Engineer*, of London, but without stating the location of the engines. An engine at Winington has been run from 20 to 130 days without shutting down, and Messrs. Mather and Platt have run a Korting engine of 750-H.P. at full load night and day for a week at a time, only stopping it to make examination. The Premier Gas Engine Company has frequently run engines of from 400 to 600 H.P. for three and four weeks at a time continuously. This record is sufficient to establish the reliability of gas engines upon a very satisfactory basis.

THE SPRING MEETING OF THE NATIONAL MACHINE TOOL BUILDERS' ASSOCIATION.

An important meeting of the National Machine Tool Builders' Association was held at Cincinnati, Ohio, on Tuesday, April 26, this being the occasion of their semi-annual conventon. A large attendance was present, the membership now including 43 machine tool builders, three of whom were added at this meeting.

The association passed a resolution reaffirming the resolution, adopted at the last meeting, at New York City, which bound the members to maintain the present schedule of prices. Interesting papers were read by P. E. Montanus, of the Springfield Machine Tool Company; by F. L. Eberhardt, of Gould & Eberhardt, and by A. H. Tuechter, of the Cincinnati Machine Tool Company.

Mr. Montanus, in his paper entitled, "The Work of the Machine Tool Builders' Association," pointed out the good work that the association had done in maintaining prices during the present depression in the trade. He called attention to the fact of the decrease of net profits on the average line of machine tools, prior to the formation of the association, to a point where it was no longer profitable to the builders to make them. This was shown to be not only due to competition, but also to the increase in wages and in cost of raw material, in addition to which it became necessary to redesign many types of machines; weights had been increased, and many improvements had been added, such as gear guards, micrometer indexes, etc. The engine lathe had increased from 25 to 40 per cent. in weight, as had also planers, shapers, drills, milling machines, etc. Mr. Montanus stated that he did not believe it possible or advisable for the machine tool builders ever to form a trust, but thought that they should be united harmoniously in order to aid in advancing security and safety in business operations.

This association, which was formed in 1902, has succeeded in restoring normal prices in some lines, in eliminating certain defects in the prices of detailed parts, and in bringing about a better feeling of confidence. Mr. Montanus presented an elaborate and comprehensive argument, in which he gave detailed figures to show the value of the association; as, for example, in 1903, when prices were advanced from 5 to 10 per cent. and demoralization of the business was averted.

Mr. A. H. Tuechter, in an interesting paper upon "The Condition of the Upright Drill Trade," spoke about the general conditions of the market trade. He said that during the recent depression nearly every dealer and user asked for lower prices, but that such prices had been repeatedly refused. He cited a number of cases to show what could be done if the builders would stand firm. He thought that the drill makers were not making any money, and had only themselves to blame for this condition; it seemed to him that as a remedy they should organize and fix prices.

The officers of the Association are as follows: President, William Lodge, Cincinnati, Ohio; 1st vice-president, W. P. Davis, Rochester, N. Y.; 2d vice-president, F. E. Reed, Worcester, Mass.; secretary, P. E. Montanus, Springfield, Ohio; treasurer, Enoch Earle, Worcester, Mass.

An interesting feature of this convention was the banquet which was given to the visiting members by the local members at the Queen City Club in Cincinnati. This event was most pleasant and delightful, Mr. Philip Fosdick presiding as toastmaster in his own inimitable manner. A humorous diversion was presented at the banquet in the form of a "mechanical" (?) menu card, which is presented below, with a partial interpretation.

POSITIVE-FEED ARRANGEMENT.

DEMONSTRATION AT QUEEN CITY CLUB.
Tuesday, April 26, 1904.

MENU.

Drop Forgings.
Blue Prints.
Condensed Steam.
(No indicated horse-power.)
Plan(k)ed Shad, with Turned Potatoes.
Rhine Wine, 110 Volts, Alternating Current.
Spring Lamb; Mint Sauce with Ball Bearings.
Blowhole Cement.
Philadelphia Dovetails.
Salad; Apprentice Lard Oil Dressing.
Champagne, 500 Volts, Direct Current.
Cold Shot Castings.
Cheese, Double Back Geared.
Cutting Oil.
Valvoline.
Taper Pins.

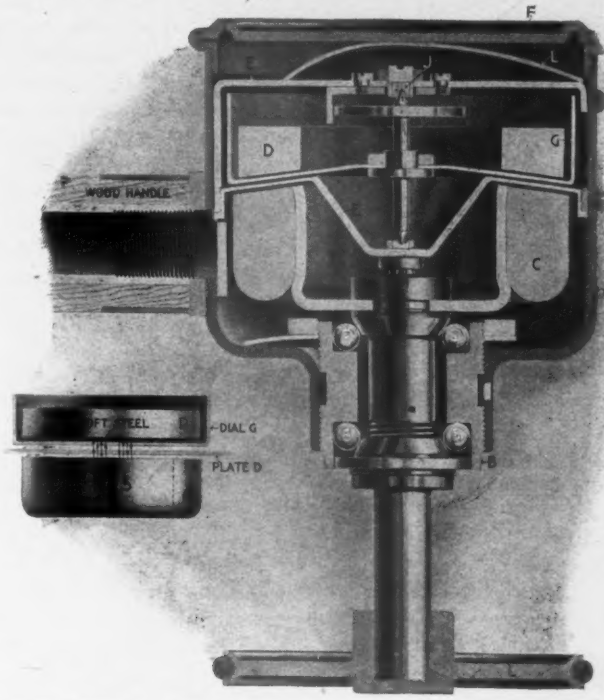
INTERPRETATION.

Drop Forgings—Cocktail.
Blue Prints—Blue points.
Condensed Steam—Soup.
Ball Bearings—French peas.
Blowhole Cement—Sherbet.
Philadelphia Dovetails—Squabs.
Cold Shot Castings—Ice cream in forms.
Cheese—Brie.
Cutting Oil—Brandy.
Valvoline—Coffee.
Taper Pins—Cigars.

THE CUT-METER—A TACHOMETER FOR INDICATING CUTTING-SPEEDS UPON MACHINE TOOLS.

The keen competition of the last few years, supplemented by the rapid increase of use of the new high-speed tool steels, has had the effect of practically revolutionizing machine shop practice. The increased production which is now sought, where formerly easy-going methods were thought sufficient, has made such heavy demands upon the machine tools, their builders and even the tool operators, that important studies are now made of the possibilities of various cutting speeds, feeding rates, depths of cut, etc., with reference to maximum production. One of the greatest difficulties that has been met in the studies of this kind has been that of the lack of means of quickly and accurately determining the cutting speeds of working in the machine tool. This has usually been determined by the laborious and frequently inaccurate method of calculation from the known countershaft speed and pulley ratios.

The demand has been very great for some time past for some



CROSS SECTION VIEW OF THE CUT-METER, SHOWING DETAILS OF CONSTRUCTION AND INDICATING MODE OF OPERATION.

METHOD OF USING THE CUT-METER TO INDICATE THE TABLE SPEED OF A PLANER.—GIVES EXACT CUTTING SPEED INSTANTLY WITHOUT CALCULATIONS.

IEW OF THE CUT-METER, AS USED FOR MEASURING CUTTING SPEEDS ON MACHINE TOOLS.

form of an instrument, in the nature of a tachometer, which could be arranged to indicate directly in cutting speed, but up till recently no device of this nature has been devised which is capable of ready application to any type of machine tool

and of simple and compact construction warranting its continual use in machine shops. Such a device is illustrated herewith, and is appropriately called the "cut-meter." It is a portable tachometer, the dial of which is calibrated to read directly in feet per minute. An accompanying sectional view shows clearly the construction.

The principle of centrifugal force or hydraulic pressure is avoided in this instrument. It consists of a circular magnet, mounted on the shaft, carried by ball bearings, in front of which is a soft steel ring which deflects magnetic lines of force through an aluminum disk. This disk is mounted on a hardened steel shaft supported by jewel bearings, and on its outside edge are engraved figures which indicate the speed; this is resisted in turning by a hairspring attached to the shaft, which brings it back to the zero point when the magnet is at rest. Attached to the main shaft outside of the case, is the driving wheel, which has a rubber tread, or tire.

The magnetic lines of force flow from the negative pole through the aluminum disk to the steel plate and back again through the disk to the positive pole of the magnet; therefore, when the magnet is revolved, a dragging action is set up in the disk, the intensity of this action being in proportion to the speed of the magnet. The resistance of the hairspring to the rotation of the disk has a similar counter effect, so that the displacement of the dial is directly proportional to the rotative speed of the magnet; thus, the scale can be graduated in equal divisions representing feet per minute at the periphery of the driving wheel with rubber tire.

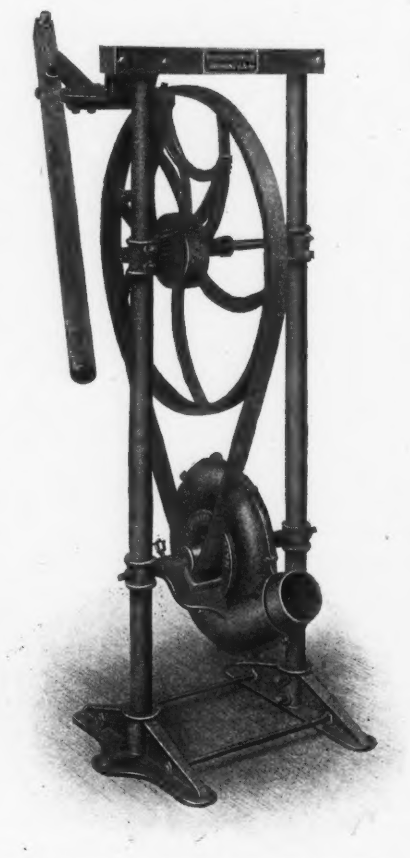
In the construction of the instrument the jewel bearings and steel ring are placed in an inner case, which may be removed at will, as shown in the detail view presented herewith. This inner case protects the dial from air currents set up by the revolving magnet, the opening through which readings are taken being covered by glass. In order to provide for permanence of the magnets they are aged after being hardened and magnetized; after this they are tested and again laid aside for a considerable interval, then retested. A change in strength too slight to be appreciable in actual work can be detected, and if the magnet has changed it is discarded. The air gap of this magnet is but 1-32 in., being so narrow as effectually to prevent influence upon the instrument by outside magnetic forces. The makers state that cut-meters have been used in constant and severe service for a year and then found to be as accurate as when first assembled. The machine is extremely durable, and the dial and shaft are very light, so that practically no stress comes upon their bearings.

The use of this instrument in the machine shop will be not only of great value but also of universal interest. The Warner Instrument Company, makers of the device, state that in testing it in one modern shop the cutting speed of a motor-driven tool running on soft steel was found to be 159 ft. per minute, but upon taking the average throughout the shop on the same stock, the average cutting speed was but 24 ft. per minute. In another shop two boring mills were indicated, the speed of one being 160 ft. and of the other 22 ft. per minute, the feed being practically the same in both cases. The difference in diameter of work makes it difficult to guess anywhere near the true speed, and in one instance a superintendent looking at a machine guessed the cutting speed at but one-quarter of the actual figure. A large number of tests have shown that, with modern equipment, working speeds run only from 25 to 50 per cent. of the speed that should be used to obtain the most profitable results. Little study of these figures is required to show the advantages to be obtained by use of this device for keeping track of machining conditions in a shop.

This cut-meter is manufactured by the Warner Instrument Company, Beloit, Wis., who have devoted unlimited care and expense in perfecting it. It is made for use at any desired speed. As adapted for use in the machine shop it is calibrated to indicate from 0 to 250 ft. per minute cutting speed, the smallest fraction of speed change indicated by it being a change of 1-5 of 1 per cent. An accompanying illustration shows the method of operating the instrument, in readig the cutting speed of a planer; the simplicity and practicability of its use in the shop are made evident in this instance. The makers will be pleased to furnish any additional information regarding this interesting new device upon application.

THE IMPROVED STURTEVANT HAND BLOWERS.

In these modern times devices are sought which will accomplish the greatest results with the least expenditure of time and exertion. To this fact, doubtless, more than any other was due the rapid introduction of the hand blower as a substitute for the old time bellows.



THE NEW STURTEVANT HAND BLOWER.

During the years which have elapsed since this change the B. F. Sturtevant Co., Boston, Mass., who have been pioneers in the manufacture of blowers, have been perfecting their design and construction until their hand blower, known as style A, has shaped itself into a new design, known as Style B, as herewith illustrated.

These hand blowers have been extensively introduced in connection with new forges of all kinds, and have likewise been applied to old style brick and iron forges as simple, efficient and economical substitutes for the bellows. Not only are they adapted to forge blowing but can readily be applied as portable ventilating apparatus.

The blower is adjustable on the shaft and its outlet may thus be set to discharge in any direction and readily connected to the forge tuyere by means of galvanized iron piping. The blower is of cast iron, strongly constructed in every particular, has a steel shaft running in babbitted boxes and a fan wheel of galvanized steel solidly riveted to a composition hub with extended arms.

The frame is carefully designed, well braced, and is so arranged that the slackness of the belt driving the blower may be taken up by lowering the blower shaft, which is supported by collars sliding on the frame. The feet are provided with holes so that the hand blower may be readily screwed to the floor.

These hand blowers are made in two sizes. The total length on the floor of Style B-1 is 18 ins., while the total height of the frame is 48 ins. The driving wheel is 24 ins. in diameter, the blower outlet is 3½ ins. in diameter, and the complete outfit weighs but 135 lbs. Style B-2 is of slightly larger dimensions, and has proportionately greater capacity for delivering air. The driving wheel is 24 ins. in diameter, the blower outlet is 4¾ ins. in diameter, and the complete outfit weighs 15[illegible] lbs. Further information regarding these blowers may be had upon application to the manufacturers, the B. F. Sturtevant Company.

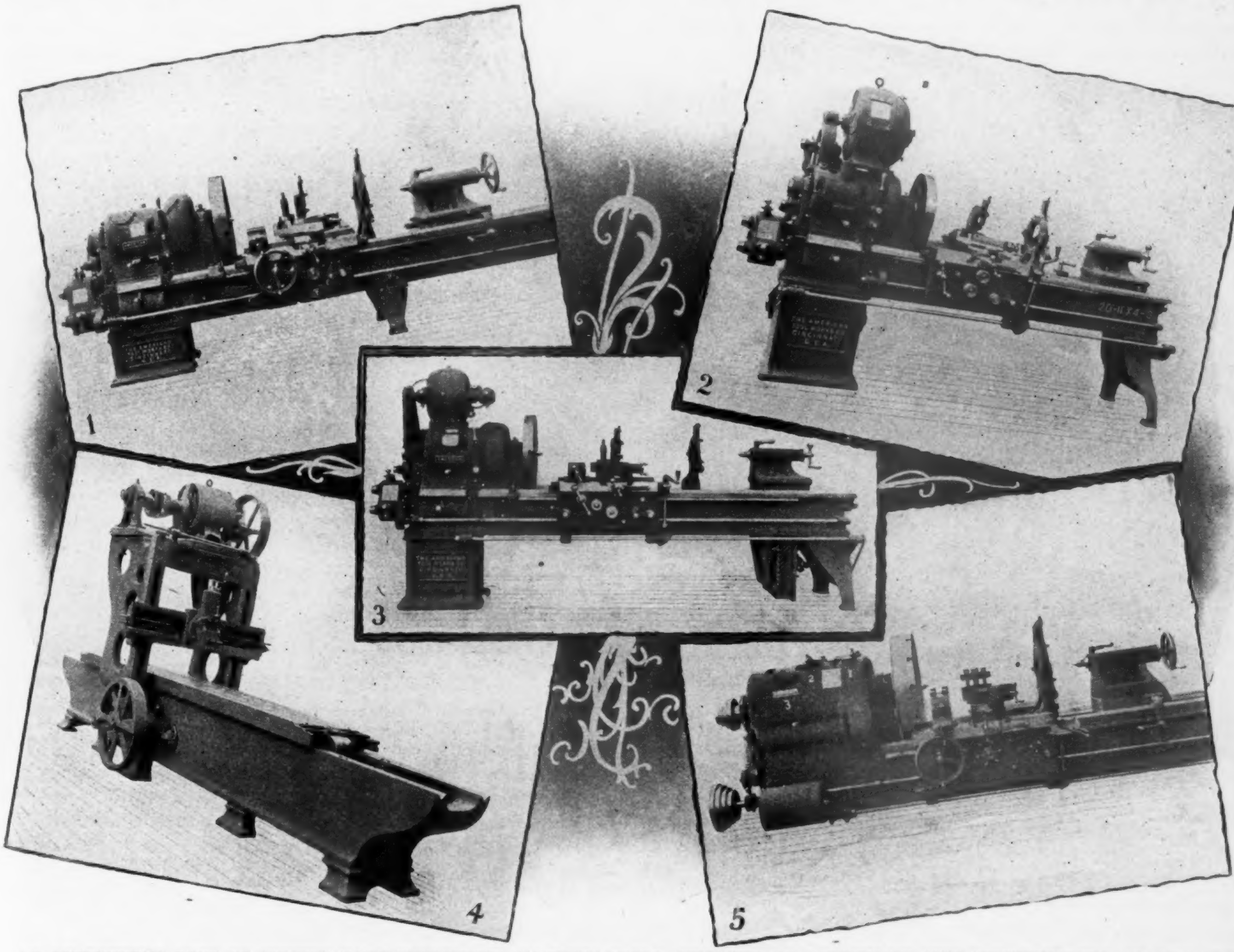
A MODERN LINE OF MACHINE TOOLS.

AMERICAN TOOL WORKS COMPANY.

The recent developments in machine tool building have been both interesting and remarkable. The demands of the new methods of rapid production have been severe upon the machine tool builder, but the efforts made to meet them have been very commendable, and even greater than would have seemed possible. The American Tool Works Company, Cincinnati, Ohio, have made unusual preparations for their trade in this new machine tool era by the redesigning of their entire line, from lathes to shapers and planers. Each model of their new line of tools embodies the latest and best ideas of recent designs of metal working machinery, and are worthy of the careful attention of all interested in machine shop betterment.

gears being oppositely disposed on the spindle and driving shaft. The speed changes are obtained instantly while the lathe is in full operation, by an improved form of clutch and lever mechanism. The whole is encased in a neat and symmetrical box with provision for easy access to working parts, and ample means for lubrication. The great flexibility of this construction is a very important factor, as a machine installed as a belt-driven lathe may be readily converted into a motor-driven lathe at any future time—the motor being connected to the driving shaft by gear or silent chain—and also may be set at any angle to overhead works, or driven from the floor below.

Fig. 2 shows the new 18 in. American lathe, driven through this all-gear head by a 5-h.p. Crocker-Wheeler motor, substantially mounted on brackets cast integral with the gear cover and direct connected through gearing to the driving shaft on



AN INTERESTING LINE OF MODERN RAPID-PRODUCTION MACHINE TOOLS, DESIGNED TO ANTICIPATE THE REQUIREMENTS OF THE NEW HIGH-SPEED TOOL STEELS.—AMERICAN TOOL WORKS COMPANY.

We are enabled to present herewith some representative illustrations of this excellent line, from which an idea may be gained of their leading features. Four of the important new designs of the "American" lathe and the new "American" planer are illustrated in the accompanying half page view, and in a separate engraving is shown the new "American" shaper, with an excellent design of variable-speed drive.

Fig. 1 is an illustration of the new design of "American" lathe with an all-gear head, obviating the use of cone pulleys entirely for obtaining changes of speed. This tool may be arranged for either belt driving or the motor drive; in this case it is shown equipped for belt driving. The headstock is a complete unit, to which any type of motor, constant or variable speed, single or multiple voltage, may be readily connected, by setting the motor either on top or at the rear of the gear casing. The construction is very simple and powerful; only six gears are required for the mechanical speed changes, the

the all gear head. This all gear head gives a wide range of speeds to the spindle also. The controller is located at the back of the leg and is actuated by the crank handle at the right hand side of the carriage.

Fig. 3 shows one of the 20 in. American lathes, with the same construction of all gear head, but here driven by a 3-h.p. Northern motor, which, in this instance, is connected to the first driving shaft of the all gear head through a Morse silent chain. The controller is attached to the underside of the bed where it is, as in the other instance, entirely out of the way, and yet readily accessible. It is similarly actuated by a crank handle at the right hand of the carriage. The manipulation of this handle starts, stops or reverses the machine, and a slight movement of same will increase the speed of the spindle by a small increment over the preceding speed. Thus, the four fundamental speeds obtained through the all gear head, which on this lathe has a range of from 5 to 322 r.p.m., are

supplemented by a great number of minute variations of speed obtained through the controller electrically. By actual tests on the 20 in. lathe, twenty-three distinct changes of speed are obained through the controller, and this, with the four changes through the all gear head, gives a range of 92 speeds at the spindle of the lathe.

Fig. 5 presents a view of the heavy 36 in. engine lathe equipped with all gear head of the same general construction, driven by a Northern motor, which is in this instance substantially mounted on a stand back of the head, and connected to the driving shaft through a Morse silent chain. In view of the heavy nature of the lathe and the extensive use of such tools in various railroad shops, we believe that this illustration will be of unusual interest to many of our mechanical readers who are interested in railroad shop work.

Fig. 4 presents an illustration of the interesting new design of the "American" planer. This tool is the 33 in. size, and is equipped for motor driving, the motor being located upon an extension housing and driven through a silent chain. It is

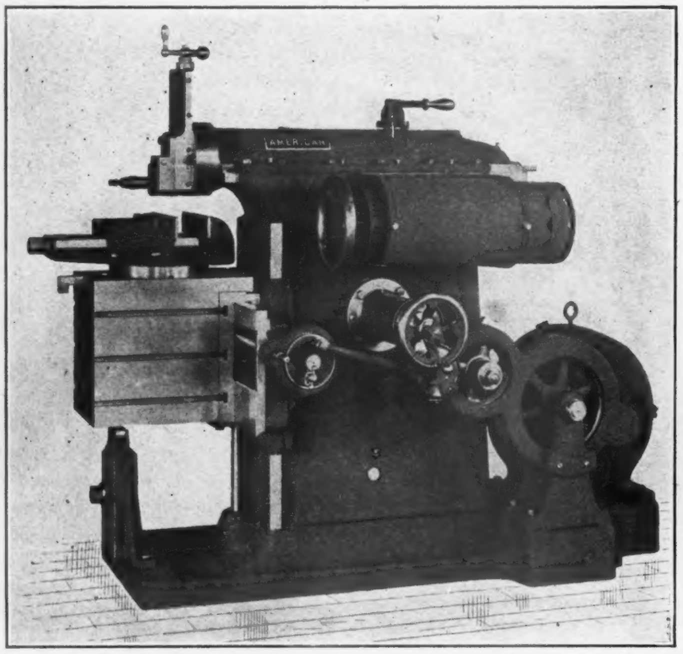


FIG. 6.—THE NEW "AMERICAN" SHAPER, SHOWING AN EXCELLENT APPLICATION OF MOTOR DRIVING.

of an extra heavy design; the bed is of deep pattern, extra wide between the Vs, thoroughly braced by box cross girts at short intervals, and rigidly supported by heavy legs. It is made unusually long in proportion to table length, leaving but little overhang to table when planing at full length. The central portion, where the gears are mounted and where the strain is heaviest, is strongly reinforced. The Vs are wide, giving good wearing surface, are scraped their entire length to a perfect fit.

The table has ample proportions. T-slots extend its entire length, and are planed from the solid, with very liberal allowance of metal around them, to obviate all spring from clamping. It is equipped with improved dirt-proof feature, which completely protects the Vs from dirt and chips. A safety locking device prevents the table from starting before the operator is ready and back dogs are so arranged that the table can be run from under the tool for examination of work.

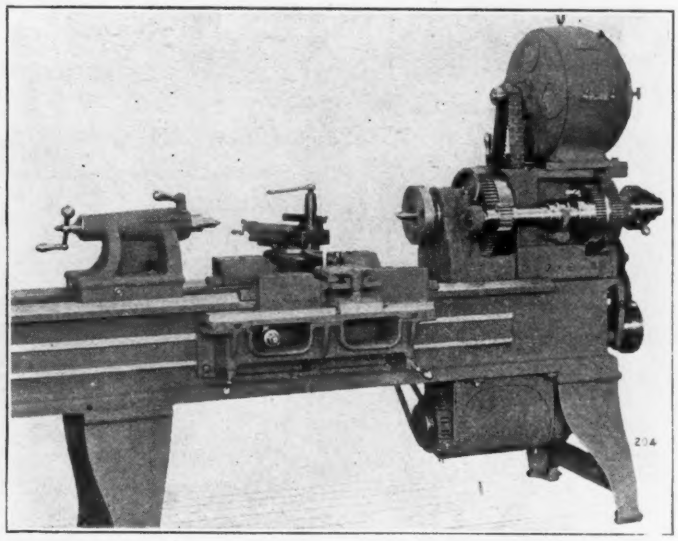
The photograph of the shaper, Fig. 6, shows one of the 18 in. American back geared crank shapers, driven by a 5-h.p. Crocker-Wheeler motor, which is mounted on a substantial base cast integral with the shaper base, and direct connected to gearing. The controller is located, as shown at the top of the column, readily at the hand of the operator.

This shaper has also many features of value. The column is unusually deep and wide, tapering slightly towards the top, giving the machine a neat and substantial appearance. It is strongly braced internally, the braces being so disposed as to meet the heaviest strains, and projects both front and rear.

The stroke of the ram is positive and has ten rates of speed, ranging from 8 to 98. Length of stroke may be changed at will without stopping the machine, through the handwheel on the side of the column.

MOTOR DRIVEN 18-INCH LATHE.

While a great deal has been published recently illustrating and describing motor drives applied to machine tools, constant progress is being made in the designing of new tools to accommodate motor drives and in the modification of old tools for the same purpose. One of these latter instances is illustrated in this photograph, showing an 18-inch Le Blond screw cutting lathe driven by a size 5 I shunt-wound Crocker-Wheeler motor. The motor is supported on a special housing and the drive is by means of a Morse silent chain from the motor shaft to the main lathe spindle. The speed control is accomplished by the Crocker-Wheeler multiple system, using in this case a size 40 M.F. 21 controller, giving a range with the controller of 21 speeds. Only a portion of this range is used as working speeds, the entire range of the tool being increased by a double back gear attachment which permits a total speed range of from 410 r.p.m. of the spindle to 5.75 r.p.m.



18-IN. LE BLOND LATHE DRIVEN BY CROCKER-WHEELER MOTOR.

With this entire range three runs of gearing are provided, one being direct and the other two through back gears. Each of these various runs is controlled by a friction clutch, the lever for operating which is located in front of the head stock. About 40 speeds are provided with 2.8 h.p., available at any speed between 20 and 410 r.p.m. of the spindle. For the heaviest working range of the tool, however, namely, 28 to 124 r.p.m., 3.4-h.p. is available.

The whole equipment is well laid out, the speed changes are accomplished quickly and easily, and the strength of motor and gearing is sufficient to accommodate cutting speeds in cast iron and soft steel of 70 ft. per minute. One prominent feature of the Crocker-Wheeler multiple-voltage system is that it affords speeds to properly use these high cutting speeds and gives ample power at all speeds without an excessively large motor.

Mr. Edwin T. James, master mechanic of the Lehigh Valley at Buffalo, has been appointed shop superintendent in charge of the extensive new shops of this road at Sayre, Pa., reporting direct to Mr. A. E. Mitchell, superintendent of motive power. Mr. James entered the service of this road in 1876 as a machinist at Easton, and has passed through the positions of round house foreman, general foreman and master mechanic. This is a particularly pleasing and significant appointment, pleasing because of the opportunity which comes to an efficient officer, who has been long in the service of this company, and it is significant of a change in organization, necessitated by the large modern shop plant.

PUBLICATIONS.

WIRE ROPE LUBRICATION.—A pamphlet is issued by the Joseph Dixon Crucible Company, Jersey City, N. J., describing the wearing of wire rope and indicating methods of properly lubricating it by means of their rope dressing, which lubricates but does not collect dust, and prevents rust.

PINTSCH LIGHT STEAM HEAT.—The Safety Car Heating & Lighting Company have issued memorandum booklets for distribution among visitors to their exhibits at the World's Fair in St. Louis. These serve to locate the exhibits of this company. They illustrate some of their specialties and also provide convenient memorandum pages for notices concerning the exposition.

SKYLIGHT GLAZING.—A pamphlet on the Halliwell system of skylight and glass roof construction has been received from Josephus Plenty, 215 Randolph avenue, Jersey City, N. J. It illustrates and describes the construction as applied to very large roofs of well-known manufacturing establishments, foundries, machine shops and railroad stations.

DISC VENTILATING FANS.—The American Blower Company, of Detroit, have issued a catalogue, No. 161, illustrating their "A B C" disc ventilating fans for mechanical draught apparatus, exhausting, for dry kilns, heat apparatus, and dust separators. The long experience of this company gives confidence to those who consult them in their specialty, and this pamphlet, which gives details and dimensions, will be found valuable in preparing designs for apparatus of this character. Copies of the pamphlet will be sent upon application.

A BIRD'S EYE VIEW OF LAKE WINNIPESAUKEE.—The numerous vacationists who annually journey to Lake Winnipesaukee, and those persons intending to take a vacation in this section, will be interested in the new publication issued by the Passenger Department, Boston & Maine Railroad, Boston. It is a bird's eye view of Lake Winnipesaukee, the different glens and coves on the lake and the hundreds of islands. Each mountain peak, island and cove is numbered and at the bottom is a table giving the name of each number. This map is interesting and useful in furnishing one with the geography of the lake, and prospective vacationists and New Hampshire enthusiasts should send six cents in stamps to the General Passenger Department, Boston & Maine Railroad, Boston, for it.

SOFT WATER.—Under this title a large water-softening installation, with a total treating capacity of 348,000 gallons per hour, is described in a handsome pamphlet by the Kennicott Water Softener Company, Railway Exchange, Chicago. It is a reprint of the series of articles from the AMERICAN ENGINEER AND RAILROAD JOURNAL describing the installation of their water softeners upon the Pittsburg & Lake Erie Railroad. The pamphlet is of great importance to railroad officials in that it describes the complete equipment of the entire railroad with water softeners to such an extent as to render it unnecessary for any of the locomotives on the road to use other than treated water. The articles were prepared for this journal with great care and by aid of the officials of the railroad who were directly responsible for the installation. We consider it the most definitely valuable work on the subject of water softening thus far available. The Kennicott Company has done a service to the railroads in distributing this valuable and handsome pamphlet.

Engineers' Arithmetic, by Fred H. Culvin and W. L. Cheney. Published by the Derrey-Cullard Company, 256 Broadway, New York. 1904; price 50 cents.

This little book is intended to give the foundation principle of such calculations as an engineer is likely to need. It is similar in its scope to Machine Shop Arithmetic and employs the same methods. It contains rules for horse power, proportions of boilers, explains indicator diagrams and includes a number of convenient tables. It is for men who operate steam engines and have charge of steam boilers.

New York Air Brake Catechism, by R. H. Blackall, author of the Westinghouse Air Brake Catechism. Norman W. Henley Publishing Company, 132 Nassau street, New York, 1904. Price, $1.25.

This is the only complete treatise on the New York air brake and air signalling practice, giving a detailed description of all the parts, their operation and troubles. It includes a full description, by aid of illustrations, of the plain and quick action triple valves, duplex valves, duplex pump, pump governor, brake and retaining valves, and of the detailed parts of this brake system, including the engineer's valve. The book also treats in special chapters the subject of piston travel, systems of leverage, water brake, piping and train handling. The author of this book is so well known through his previous work on the Westinghouse air brake as to render it unnecessary to say more of the present work except to indicate that it has received his usual careful and thorough treatment. A careful examination of the book fails to reveal any omissions. It is a guide to the New York air brake, which will be specially valuable to everyone having to do with the brake, particularly those in road service who are expected to pass examinations as to their knowledge of the brake and its operation.

Appleton's Encyclopaedia of Applied Mechanics. Edited by Park Benjamin.

Norman W. Henley Publishing Company, 132 Nassau street, New York, offer this encyclopaedia in a set of three fully illustrated volumes, handsomely bound in half morocco, for the special price of $12. Each volume contains over 900 pages and nearly 8,000 engravings. Heretofore the publisher's price has never been less than $22.50, and it has been sold only by subscription. The writers of the special articles are the best known experts in the various branches of applied mechanics, including names which are known all over the world.

Railroad Master Blacksmiths' Association. Proceedings of the Eleventh Annual Convention. Held at Buffalo, August, 1903. Edited by the Secretary, A. L. Woodworth, Lima, Ohio.

This volume contains a number of excellent papers and reports relating to blacksmith shop practice in railroad work. Making and repairing of locomotive frames, piecework vs. day work, oil furnaces, spring furnaces, dies for bulldozer work, tool steel, casehardening, flue welding and spring making are the most important of the subjects treated. This association is an important one, and its records are becoming more and more valuable as improved methods are being introduced into the smith shop. Every superintendent of motive power should inform himself with reference to the work of this organization.

Twentieth Century Locomotives. By Angus Sinclair Company. Published by Railway and Locomotive Engineering, 1 Maiden Lane, N. Y., 1904. Price $3.00.

We have just received from the press a copy of an interesting book entitled "Twentieth Century Locomotives." It is a work of 670 pages and conforms to railway standard publication sizes, being similar to the annual reports of the M. M. and M. C. B. Associations.

The subject matter of the book is largely drawn from articles which have appeared in *Railway and Locomotive Engineering*. It deals with the designing, construction, repairing and operating of railway machinery, and is intended for use by all railway men anxious to learn about railway machinery, but the book is more particularly for superintendents of motive power, master mechanics, master car builders, mechanical engineers, shop foremen, engineers, firemen and trainmen.

Among the subjects dealt with are first principles, steam and motive power, workshop operations, locomotive boiler construction, compound locomotives, operating locomotives, valve motion, forces involved in train movements, injectors, sight feed lubricators, electric headlights, steam engine indicators, machine tools and shop appliances, educational topics, miscellaneous data, workshop receipts, definitions of technical terms, illustrated descriptions and dimensions of the various types of modern locomotives and observation on the Schmidt superheater.

Various tables and engineering data are to be found scattered through the work together with simple formulas for calculating power and train resistance. The book has been carefully indexed and ready reference is easy and satisfactory.

Mr. Meyers A. Garrett has been appointed vice-president and Western representative of the Farlow Draft Gear Company, with headquarters in Chicago. Mr. Walter D. Thomas has been appointed Southern representative, with headquarters in Savannah.

Mr. H. V. Croll, who has been in charge of the Salt Lake City, Utah, office of the Allis-Chalmers Company for several years, and who was before that the representative of the E. P. Allis Company at Spokane, Wash., has been appointed to the charge of the Allis-Chalmers office in San Francisco as the successor of Mr. George Ames, who has resigned. Mr. Croll's San Francisco office is 623 Hayward Building.

NOTES.

LOCOMOTIVE & MACHINE COMPANY, MONTREAL.—The principal offices of this company have been removed from the Street Railway Chambers to the Imperial Bank Building, Victoria Square, Montreal.

WALTER A. ZELNICKER SUPPLY COMPANY.—The Chicago office of this company has been removed from the Old Colony building to the Railway Exchange building, where sufficient room has been obtained for its rapidly increasing business. The office is in charge of Mr. H. L. Schamberg.

The Canadian business of the Allis-Chalmers Company, which recently acquired the Bullock Electric Manufacturing Company, of Cincinnati, will hereafter be conducted by a new organiation bearing the name Allis-Chalmers-Bullock, Ltd. The works and principal offices of this important new Canadian company are in Montreal.

The Pneumatic Engineering Company, of New York, has just secured an order for a large air compressor, to be used in connection with the water works at Sherman, Tex. The machine is a special Rand-Corliss compressor, with Tangye frame, having air cylinders 20 and 12 x 20, and steam cylinders 9 and 17 x 20, designed for 200 pounds per square inch air pressure.

The Kennicott Water Softener Company announces the receipt of an order for one of their water softeners of a capacity of 10,000 imperial gallons from the Great Western Railway of England for the water station at Aldermaston, Berkshire, and another order for a 3,000 gal. machine, from the United Railroads of Yucatan. This company has an office at 29 Gt. St. Helens, London, and has also recently opened an office at 7 Rue Meyerbeer, Paris.

Mr. J. C. McQuiston, formerly secretary of the Westinghouse Companies' publishing department, has been appointed superintendent, and is the responsible head of that department, having in charge all matters connected with advertising, press notices and similar matters of mutual interest to the technical press and the Westinghouse Companies. In view of the responsible position which Mr. McQuiston has long held in this department and his thorough knowledge of the technical press, this appointment is appropriate and fitting.

FLANNERY BOLT COMPANY.—The Flannery Bolt Company, 339 Fifth avenue, Pittsburg, Pa., announce that the services of Mr. T. F. De Garmo have been secured to represent them in the West, with headquarters in Chicago, Ill. Mr. De Garmo will give his attention to the Tate Flexible Stay Bolt, which was illustrated in this journal last month.

FALLS HOLLOW STAY BOLTS.—The Falls Hollow Staybolt Company has just received the third large order for hollow stay bolts from the Norwegian State Railway during the past year. This is a gratifying testimonial, coming from Norway with its reputation for producing good iron. These stay bolts are made by blending iron from Norway and Sweden with a high grade of native charcoal iron, producing the necessary tensile strength and other qualifications needed in stay bolt material.

VEST POCKET MAP OF THE WORLD'S FAIR.—The Broderick & Bascom Rope Company, of St. Louis, Mo., have issued a very complete and authentic vest pocket map of the World's Fair which will be a valuable aid to visitors, as it shows methods of reaching the fair from any point in the city, giving the location of all buildings and other points of interest on the grounds. Copy of the map will be mailed upon receipt of a 2-cent stamp sent to Mr. C. E. Bascom of this company. To visitors at their exhibit handsome souvenir blotters will be given at the fair. These are well gotten up and very convenient for the desk.

The widespread interest that is being taken by railroad master mechanics generally throughout the country, in the all-important question of proper machine tool equipment in the railroad shops, is well indicated by the great number and variety of railroads which have just closed orders with the leading builders of railway machine tools. The American Tool Works Company of Cincinnati, one of the foremost and most progressive firms manufacturing machine tools for railroad work, have lately been furnishing tools of their construction to such roads as the New York Central, Pennsylvania, Central Railroad of New Jersey, Big Four, Southern, Baltimore & Ohio, Canadian Pacific, Missouri Pacific, L. & N., St. Louis & San Francisco, M., K. & T., the Hocking Valley, etc. They report that the railroad master mechanics are evidencing much interest in their new all-gear head for motor-driven lathes, a remarkable construction which we take pleasure in presenting in other columns. It warrants the close attention and study of all who are interested in such questions.

BABCOCK & WILCOX WATER TUBE BOILERS.—In a recent comparative test of Babcock & Wilcox and Stirling boilers at the power house of the Pacific Power & Light Company, at Los Angeles, Cal., the Babcock & Wilcox boiler showed decided advantages over the Stirling boiler in a number of different counts. These tests were made by a representative of the Pacific Power & Light Company, and each of the boiler companies were represented by an engineer, the report being signed by all three. In the matter of efficiency the Babcock & Wilcox boiler showed a gain of 4.93, 5.10, 7.18 and 2.97 per cent. in four tests; the temperature of escaping gases from the Babcock & Wilcox boiler was lower than that of the Stirling boiler in all four tests, and the evaporation per pound of oil (which was used for fuel), from and at 212 deg., was in favor of the Babcock & Wilcox. In the matter of efficiency in normal as well as in forced working, the Babcock & Wilcox showed superiority. Comparative records obtained under such circumstances, which are signed by one independent and two interested engineers, are very rare. The Babcock & Wilcox Company are to be congratulated upon the results of this interesting test. Those interested should procure complete records of the tests.

RIEHLE BROTHERS TESTING MACHINE COMPANY, PHILADELPHIA, PA., report that they have received an order to design and construct for the University of Illinois a vertical-screw power testing machine of 600,000 lbs. capacity. This is the largest testing machine of this type ever built. Some specially novel features will be introduced which will make it a machine of advanced type. It is designed for the widest range of testing by tensile, transverse, and compression strains; and will take in tensile specimens 22 ft. long, allowing for 20 per cent. elongation; transverse specimens 10 ft. long, and compression specimens 25 ft. long. The machine will stand 30 ft. high above floor line, will be 17 ft. long, and nearly 11 ft. wide; it will weigh about 50 tons. Nearly 15 tons of steel castings will be used in the construction of this machine. The weighing beam is one of the special features and is the most improved type of the Riehle dial screw beam. Two poises are used; the forward poise can be run out till it registers 300,000 lbs., when it will automatically release itself; then the other poise can be thrown in and out, or if preferred, both poises can be run out together. All the weight is registered on the weighing beam and no loose weights are required. This company also recently delivered to the University of Illinois a 100,000-lb. testing machine; in addition to which they have furnished the Simplex Railway Appliance Company, Hammond, Ind., a 300,000-lb. car bolster testing machine, a 100,000-lb. spring tester, and a 75,000-lb. closing press; Lafayette College, Easton, Pa. with a 200,000-lb. testing machine and torsional machine and the Philadelphia Veneer & Lumber Company, with two Smith veneer cutting machines.

CHICAGO PNEUMATIC TOOL COMPANY.—The litigation of this company against the Keller Company and the Philadelphia Pneumatic Tool Company, covering infringement of the Boyer pneumatic hammer, has been terminated in favor of the Chicago Pneumatic Tool Company by the granting of a final decree for perpetual injunction and accounting; this decision declares the validity of the Boyer patent and the infringement of claims which were under litigation. The defendants are enjoined from the manufacture, use, or sale, of pneumatic tools covered by these patents. The date of this decision and injunction is April 9, 1904. In addition to this decision, Judge Hazel, of the United States Court, on April 30 handed down a decision sustaining the Moffet drill patent, and held the Philadelphia-Keller drills to be infringements thereof, granted the decree for accounting for profits and damages, and injunction prohibiting the further manufacture, sale or use of such drills. A similar decision was granted previous to this, but it covered the feed screw only, whereas the latter decision covers the drill itself. This decision is the result of a final hearing upon pleadings and full proofs, and it places the Philadelphia Pneumatic Tool Company under complete legal restraint whereby they are now enjoined from manufacturing, selling, or using, or permitting, or authorizing others to sell or use such drills irrespective of whether they are, or are not, provided with feed screws, for the sustained claims cover the drill proper, irrespective of the feed screw. This decision secures to the Chicago Pneumatic Tool Company the exclusive right to manufacture and sell, and authorize others to sell and use the modern pneumatic drill, as this company is advised that all other pneumatic drills on the market infringe the sustained claims of the Moffet patent, and are completely within and covered by this decision.